PETROLEUM GEOLOGY OF THE ARBUCKLE GROUP, SOUTHERN OSAGE AND EASTERN PAWNEE COUNTIES, OKLAHOMA

By

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TABLE OF CONTENTS

Chapter		Page
I.	ABSTRACT	1
II.	INTRODUCTION	3
	Location of the Study Area	3
	Methods and Procedures	3
	Previous Investigations	5
III.	STRUCTURAL FRAMEWORK	10
	Regional Structural Geology	10
	Structural Geology of the Study Area	10
	Structure of the Pink Limestone Marker Bed	14
	Structure of the Top of the Arbuckle Group	14
	Comparison of Structure of the Pink Limestone and the Arbuckle	15
	Evolution of Folds	35
IV.	STRATIGRAPHY	38
	Regional Stratigraphy, Arbuckle Group	38
	Local Stratigraphy, Arbuckle Group	38
	Lithology of Arbuckle Rocks	38
	Correlation of Units Within the Arbuckle	41
V.	PETROLEUM GEOLOGY	42
	History of Arbuckle Development	42
	Traps and Arbuckle Production	47
	Traps Related to Folding	47
	Traps Related to Folding and Stratigraphy	49
	Stratigraphic Traps	50
	Traps Related to Faulting	50
	Wellsite Evaluation of Rocks of the Arbuckle Group	52
	Drilling-Time Logs	52
	Gamma Ray-Porosity Logs	53
	Kinds of Porosity Within the Arbuckle	53
	Evaluation of Shows of Hydrocarbons	54
	Economics of Oil and Gas Production From the Arbuckle Group	61

Chapter Page

VI. CONCLUSIONS 63

SELECTED REFERENCES 65

APPENDIX - LOCATIONS OF WELLS SHOWN ON CORRELATION SECTIONS . . . 68

LIST OF TABLES

Table		Page
I.	Summary Statistics, Structural Geology of Boston Field, Sec. 1, T. 21 N., R. 7 E.	18
II.	Summary Statistics, Structural Geology of Buell Field, Sec. 27-29, T. 23 N., R. 9 E.	20
III.	Summary Statistics, Structural Geology of Canyon Creek Field, Sec. 17, T. 23 N., R. 10 E.	22
IV.	Summary Statistics, Structural Geology of South Canyon Creek Field, Sec. 32, T. 23 N., R. 10 E.	24
V.	Summary Statistics, Structural Geology of North Blackburn Field, Sec. 5, T. 22 N., R. 7 E.	26
VI.	Summary Statistics, Structural Geology of Pettit Field, Sec. 20 and 29, T. 23 N., R. 8 E.	28
VII.	Summary Statistics, Structural Geology of South Naval Reserve Field, Sec. 9, 16, and 17, T. 23 N., R. 7 E.	30
VIII.	Summary Statistics, Structural Geology of South Wildhorse Field, Sec. 11 and 12, T. 21 N., R. 10 E.	32
IX.	Summary Statistics, Structural Geology of West Wildhorse Field, Sec. 24 and 25, T. 22 N., R. 9 E.	34
X.	Cumulative Production, Fields That Produce From the Arbuckle Group, as of January, 1978	43
XI.	Summary Statistics, Economics of Drilling and Completing an Arbuckle Oil Well in the Study Area, Using South Canyon Creek Field as a Model	62

LIST OF FIGURES

Figure		Page
1.	Location of the study area on the north-central Oklahoma platform	4
2.	Locations of oil and gas fields in the study area, in Osage County	6
3.	Major structural elements of Oklahoma	7
4.	General stratigraphic column of Cambrian and part of the Ordovician rocks of southern Oklahoma (after Chenoweth, 1964)	8
5.	General stratigraphic column of Cambrian and Ordovician rocks of northeastern Oklahoma (after Chenoweth, 1964)	9
6.	Locations of oil and gas fields in the study area, in Pawnee County	11
7.	Wildhorse Field, T. 22 N., R. 10 E., in which Arbuckle locally is absent	13
8.	Structural geology of Boston Field, at the levels of the Pink Limestone and the Arbuckle Group	17
9.	Structural geology of Buell Field, at the levels of the Pink Limestone and the Arbuckle Group	19
10.	Structural geology of Canyon Creek Field, at the levels of the Pink Limestone and the Arbuckle Group	21
11.	Structural geology of South Canyon Creek Field, at the levels of the Pink Limestone and the Arbuckle Group	23
12.	Structural geology of North Blackburn Field, at the levels of the Pink Limestone and the Arbuckle Group	25
13.	Structural geology of Pettit Field, at the levels of the Pink Limestone and the Arbuckle Group	27
14.	Structural geology of South Naval Reserve Field, at the levels of the Pink Limestone and the Arbuckle Group	29

Figure Page

15. Structural geology of South Wildhorse Field, at the levels of the Pink Limestone and the Arbuckle Group 31

16. Structural geology of West Wildhorse Field, at the levels of the Pink Limestone and the Arbuckle Group 33

17. Fred DeMeir 1-A Money Tree, a well that produced from the upper and lower parts of the Arbuckle 48

18. Subcrop of the Powell Formation beneath the Simpson Group . . 51

19. Example of results of drill-stem tests, Sinclair Jones 4 . . 56

20. Example of results of drill-stem tests, Wichita Industries, South Wildhorse 1-C 57

21. Example of results of drill-stem tests, Burke Osage 1-B . . . 58

22. Example of results of drill-stem tests, Sunray Osage 1-B . . 59

23. Example of results of drill-stem tests, Producers Stevens 1-A 60

LIST OF PLATES

Plate		Page
1.	Pink Limestone structure map	(in pocket)
2.	Arbuckle structure map	(in pocket)
3.	Isopachous map, top Pink Limestone to top Arbuckle Group	(in pocket)
4.	Isopachous map, base Mississippian to top Arbuckle Group	(in pocket)
5.	Arbuckle production map	(in pocket)
6.	Correlation section A-A'	(in pocket)
7.	Correlation section B-B'	(in pocket)
8.	Correlation section C-C'	(in pocket)
9.	Correlation section D-D'	(in pocket)
10.	Correlation section E-E'	(in pocket)
11.	Correlation section F-F'	(in pocket)
12.	Correlation section G-G'	(in pocket)
13.	Correlation section, Big Four Bird No. 5 to Sunray S-3, Sec. 34, T. 22 N., R. 10 E.	(in pocket)
14.	Correlation of zones of porosity, Viking Boston "D" No. D-1 to Crown Central Wildhorse 31-B	(in pocket)

CHAPTER I

ABSTRACT

In the area of investigation, T. 20 to 23 N., R. 7 to 10 E., the Arbuckle Group consists almost entirely of dolomite and limestone; minor amounts of shale, sandstone and chert are included. The mounting of bit cuttings in the center of electric logs and correlation of the logs allows division of the Arbuckle Group into ad hoc units.

Locally, exploration for Arbuckle hydrocarbon production has centered around positive structural features with 20 ft or more of closure at the Pink Limestone level. Structural contour maps of the Pink Limestone marker bed and the top of the Arbuckle Group were compared and analyzed statistically to determine if a useful relationship exists with regard to structural closure, areal extent, dip and displacement of the axes of folds. Results indicate that structure at the top of the Arbuckle Group can be predicted by the Pink Limestone marker bed.

Positive structural features that existed prior to deposition of Mississippian sediments may be delineated by use of isopachous maps from the top of the Pink Limestone marker bed and base of the Mississippian to the top of the Arbuckle Group. These maps should be used in conjunction with structural contour maps of the Pink and Arbuckle. Thinning of the Arbuckle to Mississippian interval apparently is due to positive anticlinal and domal folds having existed before Mississippian time.

Four basic types of hydrocarbon traps in the Arbuckle Group are due to (1) folding, (2) faulting, (3) facies changes, and (4) combinations of folding and stratigraphic changes. Production strictly related to facies changes has not been demonstrated in the study area.

CHAPTER II

INTRODUCTION

Location of the Study Area

The area of study covers approximately 575 sq mi in northeastern Oklahoma, including T. 20 N. through T. 23 N., R. 7 E. through R. 10 E. Included are the south-central parts of Osage County and the eastern part of Pawnee County (Fig. 1).

Methods and Procedures

The framework for interpretation and solution of specific problems involved in the investigation is comprised of a structural contour map of the top of the Pink Limestone, a structural contour map of the top of the Arbuckle Group, isopachous maps from the top of the Pink Limestone and base of the Woodford Shale to the top of the Arbuckle Group, a set of cross-sections, and chip logs from well cuttings. Data were taken from electric logs and scout tickets of every well that penetrated the Pink Limestone and Arbuckle within the area, except for recently drilled wells on which data were not released. Drillers' logs from the Osage Indian Agency and Corporation Commission of the State of Oklahoma were used selectively for close study of these fields: Wildhorse (Sec. 32-34, T. 22 N., R. 10 E.), Osage-Hominy (Sec. 8, 9 and 15, T. 23 N., R. 8 E.), Barker (Sec. 1 and 12, T. 23 N., R. 7 E.), South Canyon Creek (Sec. 32, T. 23 N., R. 10 E.), and East Osage City

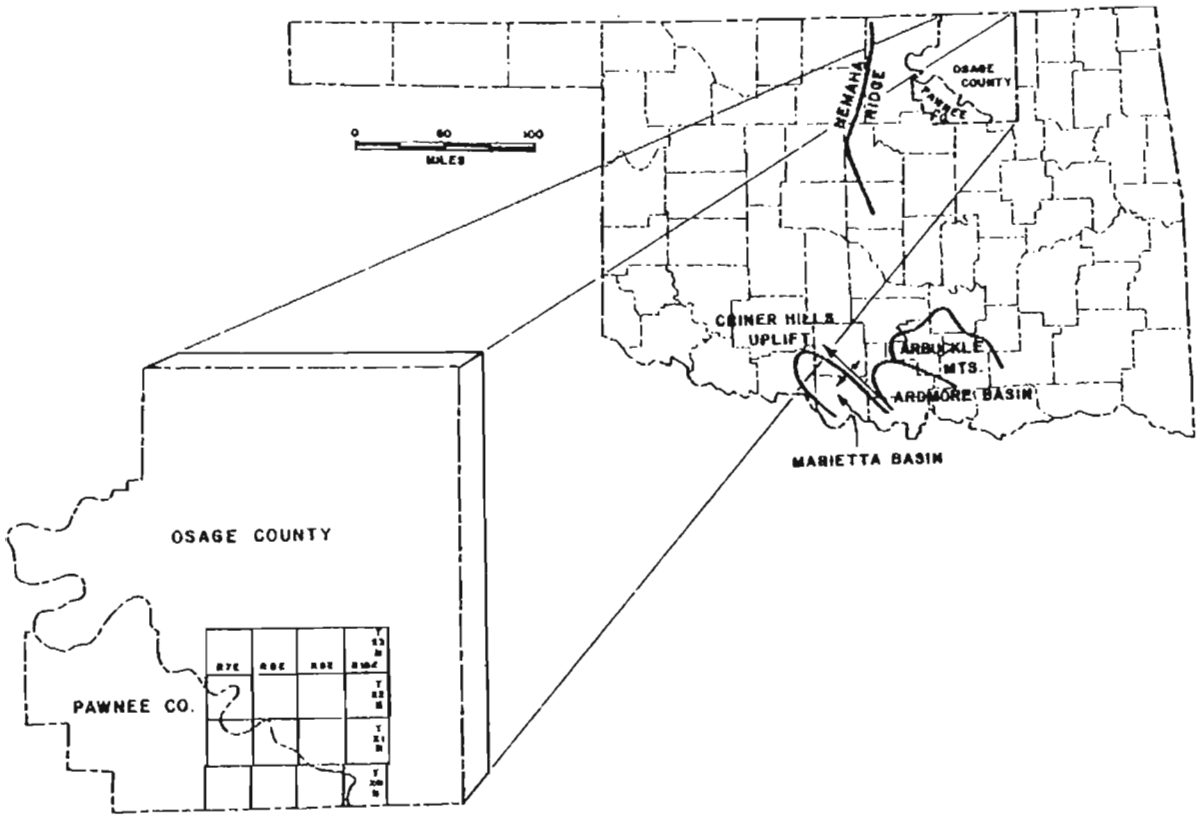


Fig. 1.-Location of the study area on the north-central Oklahoma platform

(Sec. 9, 16 and 17, T. 21 N., R. 9 E.) (Fig. 2).

Previous Investigations

The Arbuckle Group (Decker, 1928) of Cambrian and Early Ordovician age crops out mainly in the Arbuckle Mountains of south-central Oklahoma (Fig. 3). These strata overlie the Lamotte Sandstone or Reagan Sandstone of Cambrian age and underlie the Oil Creek Formation of the Simpson Group of Late Ordovician age (Fig. 4). The Arbuckle has been studied closely in the Arbuckle Mountain region (Decker, 1928; Merritt, 1928; Ireland, 1955; Windland, 1956; Harlton, 1964) where it comprises seven formations; in ascending order they are the Honey Creek, Fort Sill, Signal Mountain, McKenzie Hill, Cool Creek, Kindblade and West Spring Creek (Fig. 4). In northeastern Oklahoma the Arbuckle Group is made up of seven formations at many places (Fig. 5). In ascending order these are the Bonneterre Dolomite, Eminence Dolomite, Roubidoux Formation, Jefferson City Dolomite, Cotter Dolomite and Powell Dolomite. The Arbuckle Group of the subsurface of northeastern Oklahoma overlies the Lamotte Sandstone and underlies the Oil Creek Sandstone.

The Arbuckle Group of the subsurface also has been studied in Oklahoma and Kansas (Ireland, 1955; Harlton, 1964; Burgess, 1964; McCracken, 1964; Chenoweth, 1968; Reeder, 1974; Webb, 1976; Cardwell, 1977; and Gatewood, 1978). The work of Ireland (1955) and Chenoweth (1967) is the foundation for this study. Chenoweth dealt primarily with the early Paleozoic (Arbuckle) overlap in the southern Midcontinent of the United States. Ireland dealt with the Precambrian surface of northeastern Oklahoma and adjacent states, as it existed prior to deposition of the Paleozoic sediments.

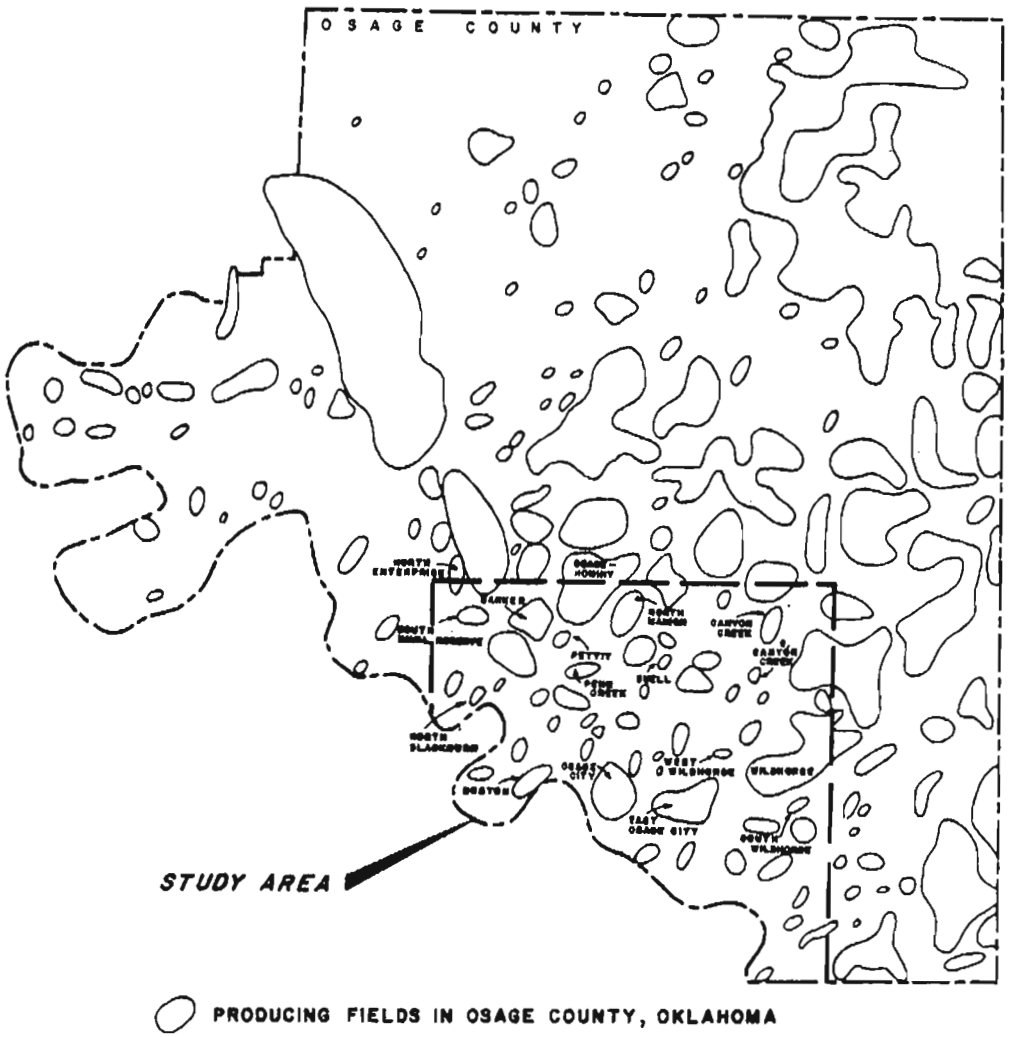


Fig. 2.-Locations of oil and gas fields in the study area, in Osage County

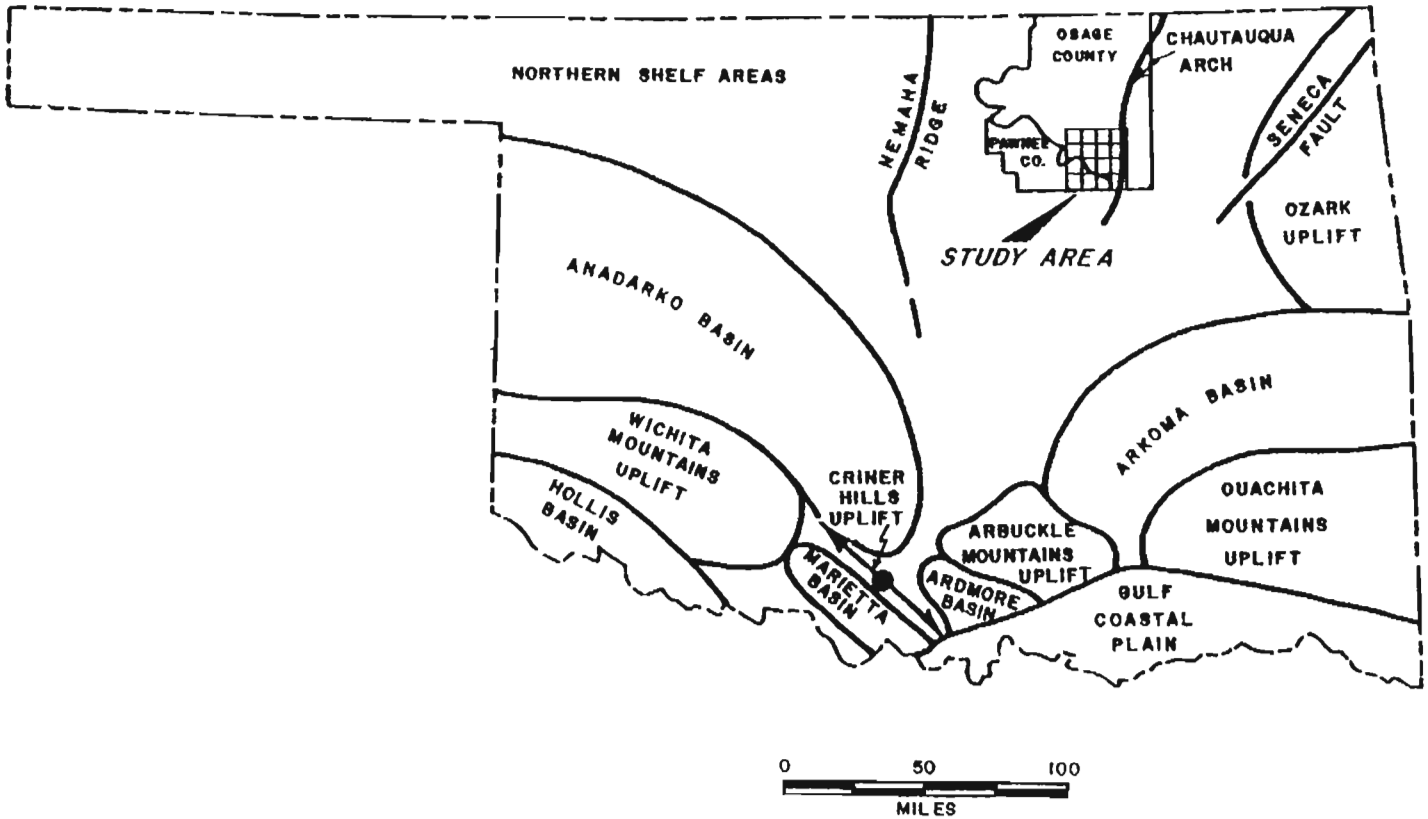


Fig. 3.-Major structural elements of Oklahoma

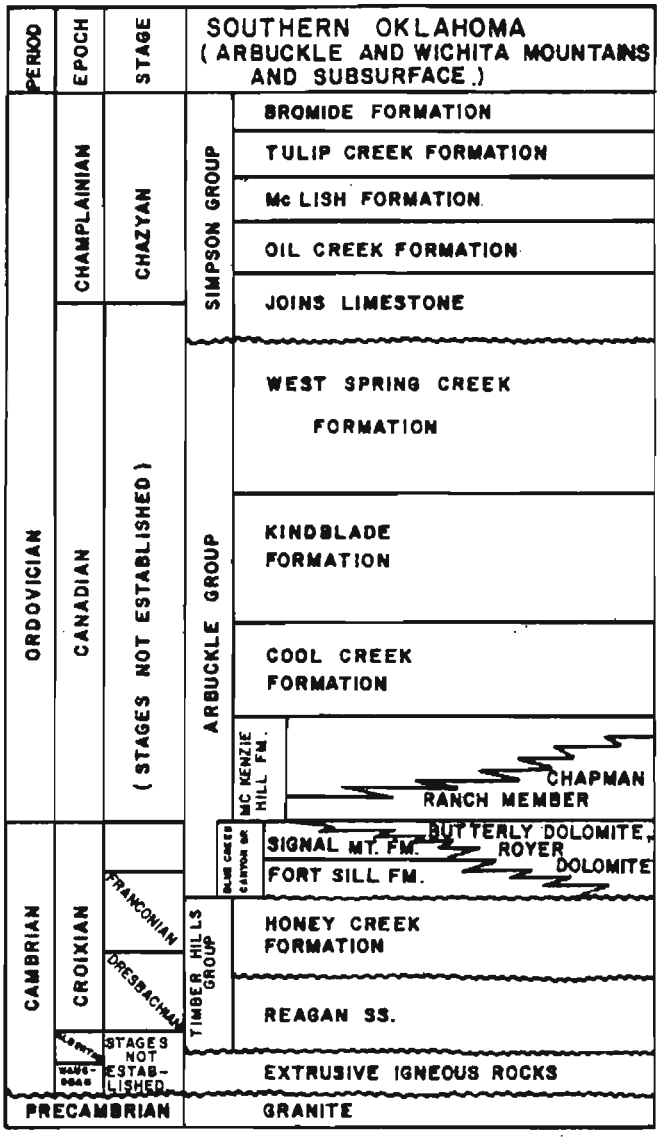


Fig. 4.-General stratigraphic column of Cambrian and part of the Ordovician rocks of southern Oklahoma (after Chenoweth, 1964)

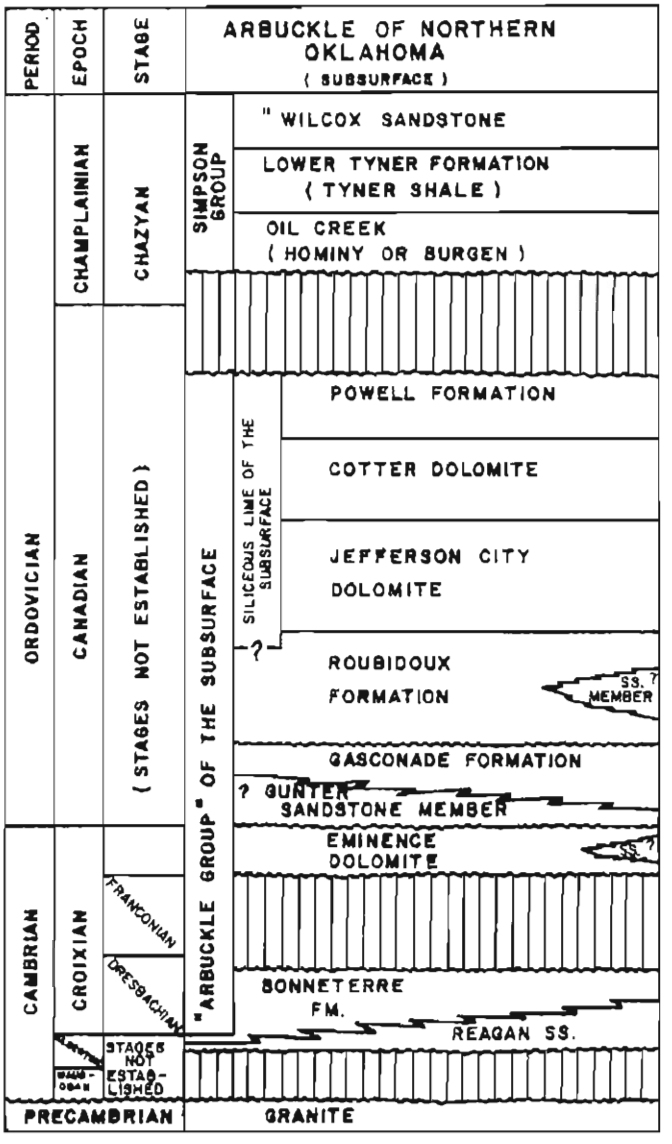


Fig. 5.-General stratigraphic column of Cambrian and Ordovician rocks of northeastern Oklahoma (after Chenoweth, 1964)

CHAPTER III

STRUCTURAL FRAMEWORK

Regional Structural Geology

The study area lies in the north-central portion of the Northeastern Oklahoma Platform. Regional tectonic provinces that border the Northeastern Oklahoma Platform are the Nemaha Ridge to the west, the Ozark Uplift to the east, the Anadarko Basin to the southwest, and the Arkoma Basin to the southeast (Fig. 3). En-echelon faults trend south-southwest through Osage County across the study area (Miser, 1954).

Structural Geology of the Study Area

The Pink Limestone (Desmoinesian) was mapped to represent the geologic structure of the study area as it is now. During the time of deposition of the Pink, and shortly thereafter, the marker bed probably showed little or no folding. Because many of the fields within the study area produce from the Pennsylvanian "Cherokee" sandstones, the Pink has been penetrated in most of the wells, and data are abundant.

The top of the Arbuckle Group was contoured to approximate the structural configuration of the Arbuckle rocks. The upper part of the Arbuckle was eroded before deposition of overlying beds and therefore, a structural contour map of the top of the Arbuckle actually depicts the combined effects of folding and paleotopography. However, in the absence of widespread, clearly defined markers within the Arbuckle

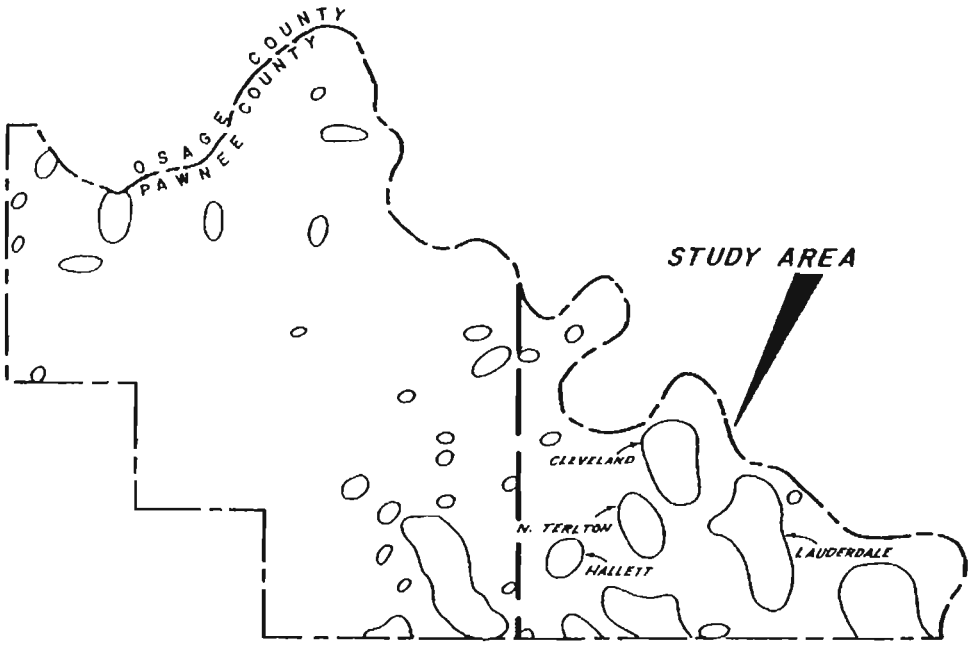
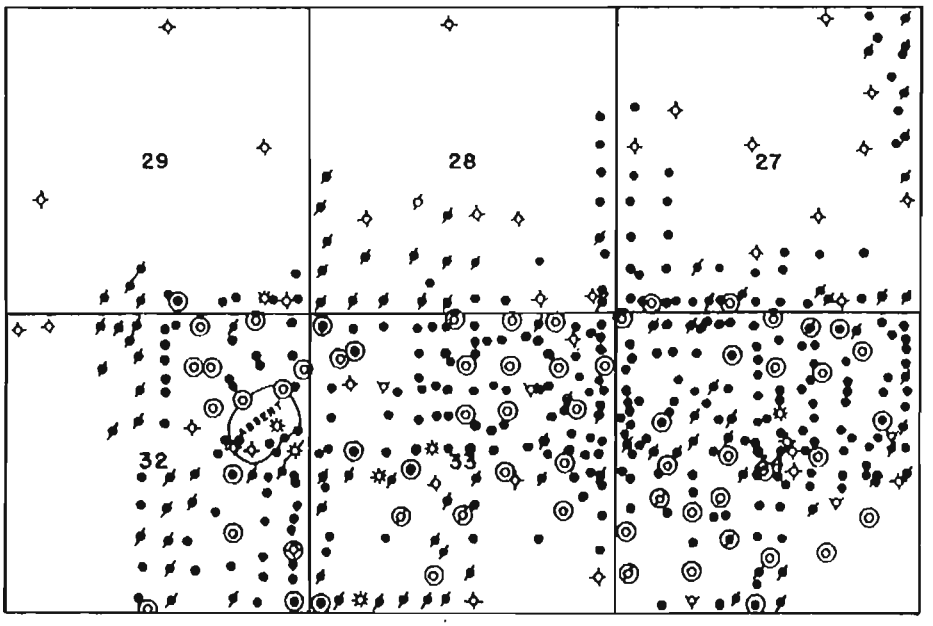


Fig. 6.-Locations of oil and gas fields in the study area, in Pawnee County

section, and because relatively few wells penetrate more than a few hundred feet of the Arbuckle, a structural-paleotopographic map of the top of the Arbuckle is the best available approximation of structural geology of the group.

Because the Arbuckle is penetrated by fewer wells than is the Pink Limestone, structure of the Pink datum was used as a guide in contouring the Arbuckle structure, especially in areas where no Arbuckle data points were obtainable. In areas where structural configuration of both Arbuckle and Pink datums is under good control, folds mapped on the Arbuckle datum show amounts of structural closure and planimetric shapes similar to folds mapped on the Pink Limestone. The larger anticlines show north-to-northeast alignment, such as Cleveland, Barker, North Manion, and Osage City (cf. Fig. 2 and 6 with Pl. 1 and 2). Several smaller structural features show less orientation in trends. These include domes and anticlines that may be related to the isolated pinnacle remnants of the Precambrian surface called the "Tulsa Mountains" (Ireland, 1955; Chenoweth, 1968; Reeder, 1974). The structures in Paleozoic rocks have been attributed partly to differential compaction over the Precambrian topography (Fritz, 1977).

In several fields in the study area the Arbuckle Group is absent from the tops of the Precambrian paleotopographic highs but is deposited in normal sequence around these ancient landforms. An example of this is the Wildhorse Field (NE Sec. 32, T. 22 N., R. 10 E.) (Fig. 7). Other instances of Precambrian rocks projecting above the Arbuckle include SW SW SW Sec. 3, T. 21 N., R. 9 E.; N½ SW SW Sec. 9, T. 21 N., R. 9 E.,; NE SW SW Sec. 9, T. 23 N., R. 8 E.; NE SE SW Sec. 9, T. 23 N., R. 8 E.; C SE SW Sec. 9, T. 23 N., R. 8 E.; NW SW SE Sec. 25, T. 23 N.,



WILDHORSE OIL FIELD
SHOWING
PRESENCE AND ABSENCE OF ARBUCKLE ROCK

ABSENT ABSENCE OF ARBUCKLE

ARBUCKLE PRESENT

Fig. 7.-Wildhorse Field, T. 22 N., R. 10 E., in which Arbuckle locally is absent

R. 8 E.; NE SE SE Sec. 25, T. 23 N., R. 8 E.; and SW NE SE T. 23 N., R. 8 E.

Structure of the Pink Limestone Marker Bed

The Pink Limestone is almost uniformly 8 ft thick throughout the study area, except locally where the Skinner Sandstone was deposited in channels eroded through the Pink.

Positive structural features in the area are anticlinal noses, domes, and anticlines, in order of abundance (Pl. 1). Generally, the noses trend northeast to southwest. Most of the noses are in Ranges 7 and 10 East; most of the domes and anticlines are in Ranges 8 and 9 East. Domes and anticlines generally show less preferred orientation among them, but they form a north-to-south pattern across the central ranges of the study area (Pl. 1). The amount of closure varies from as little as 20 ft (Sec. 5, T. 22 N., R. 8 E.) to as much as 180 ft in the Cleveland Field (Sec. 16-20, 21, 28, 29 and 30, T. 21 N., R. 8E.) (Pl. 1).

Faulting was mapped at only two localities in the study area. A north-northwest-trending fault is shown in Sec. 22, 26, and 35, T. 23 N., R. 7 E., and a second fault is in Sec. 23, 24, and 26, T. 20 N., R. 10 E. Maximal displacement on the two faults is 76 ft in Sec. 22 and 23, T. 23 N., R. 7 E., to 118 ft in Sec. 23 and 24, T. 20 N., R. 10 E.

Structure of the Top of the Arbuckle Group

Positive folds shown by the top of the Arbuckle are anticlinal noses and domes. The anticlinal noses trend generally east-west across

the study area, but a small part of the nosing has a northeast-southwest trend. Domes show little in the way of strong trends, with the exception that most of the larger domal structures are within the eastern half of Range 7, all of Range 8, and the western half of Range 9 (Pl. 2). Closure of these structures ranges from 20 ft (Sec. 9, T. 22 N., R. 7 E.) to 420 ft in the Cleveland Field (Sec. 16-21, 29 and 30, T. 21 N., R. 8 E.). Four general areas of faults were mapped at the Arbuckle level within the study area. The largest of these includes a system that extends from the North Terlton Field (Sec. 6 and 7, T. 20 N., R 8 E.) to the Cleveland Field (Sec. 17-20, 21, 29 and 30, T. 21 N., R. 8 E.) (Fig. 7; Pl. 2). The main fault trends northeastward along the eastern boundaries of these fields (Pl. 2). The North Terlton Field (Sec. 6 and 7, T. 20 N., R. 8 E.) is bounded by faults on the east, southwest, and northwest (Pl. 2). This area shows the greatest amount of displacement in the study area--340 ft near the eastern margin of the field.

Elsewhere, faults trend northwestward (Sec. 22, 26 and 35, T. 23 N., R. 7 E.), east-northeastward (Sec. 11, 15 and 16, T. 22 N., R. 8 E.), and northeastward (Sec. 23, 24 and 26, T. 20 N., R. 10 E.) (Pl. 2).

Comparison of Structure of the Pink Limestone and the Arbuckle

Close inspection of nine fields in which data about structure of the Arbuckle and Pink are abundant have produced strong evidence that folds in the Arbuckle are consistently detectable from configuration of the Pink Limestone. Fields used in this experiment were Boston, Buell, Canyon Creek, South Canyon Creek, North Blackburn, Pettit,

South Naval Reserve, South Wildhorse, and West Wildhorse (Fig. 2 and 8, Table I; Fig. 9, Table II, Fig. 10, Table III; Fig. 11, Table IV; Fig. 12, Table V; Fig. 13, Table VI; Fig. 14, Table VII; Fig. 15, Table VIII; Fig. 16, Table IX. Seven properties of domal folds in the Arbuckle and in the Pink Limestone were compared, in order to ascertain their similarities and differences. These properties were (1) numbers of control points, (2) controlled closure in feet, (3) acres within the lowest closed contour line, (4) length-width ratio using the middle closed contour line, (5) displacement of axes or crestal positions on the Arbuckle datum (if the positions were different than on the Pink datum), (6) average dips on flanks, and (7) orientations of axes. Results of the experiments are shown in Tables I through IX.

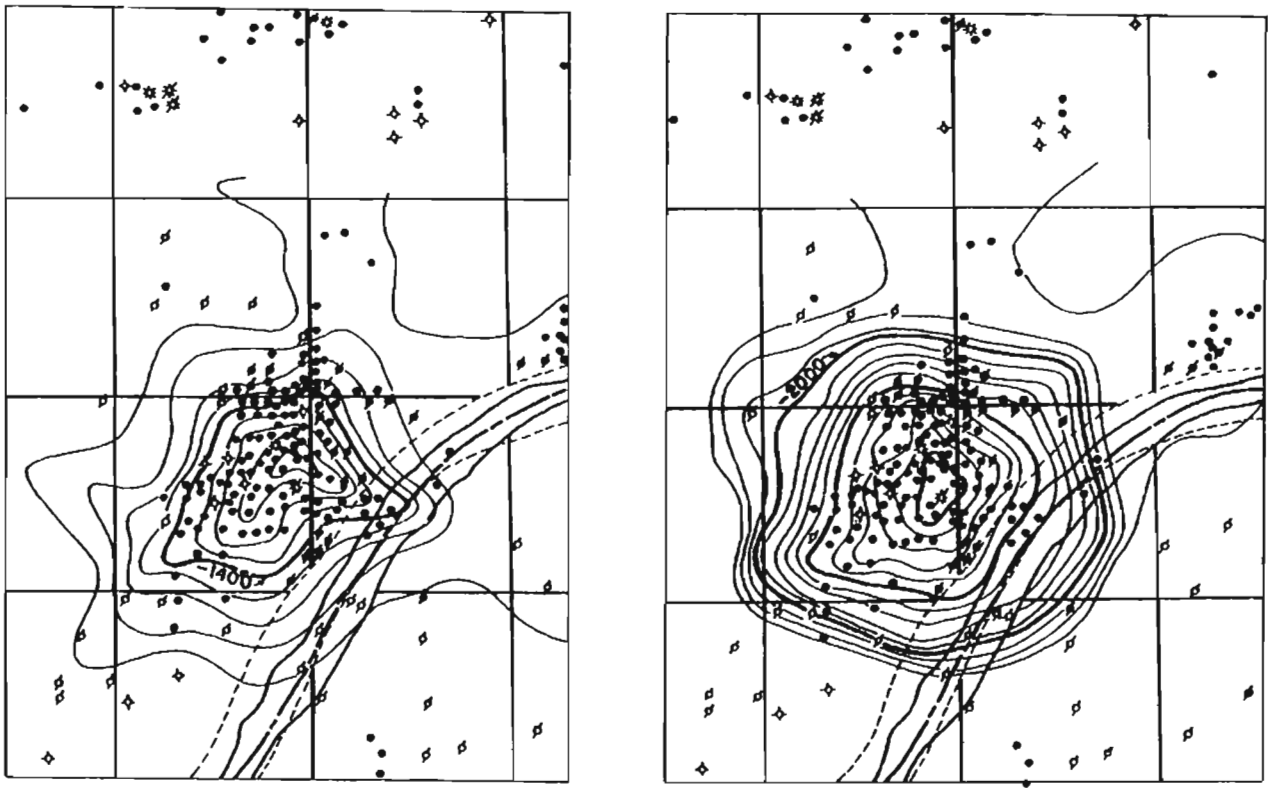


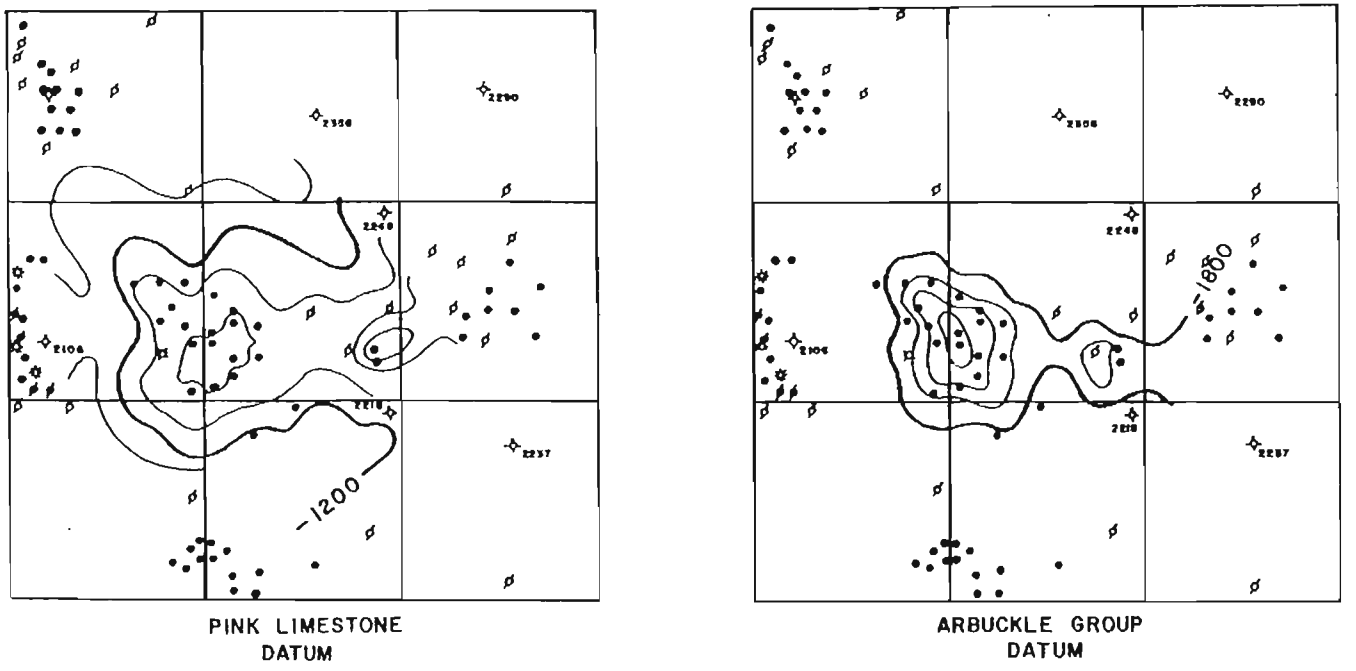
Fig. 8.-Structural geology of Boston Field, at the levels of the Pink Limestone and the Arbuckle Group

TABLE I

SUMMARY STATISTICS, STRUCTURAL GEOLOGY OF
BOSTON FIELD, SEC. 1, T. 21 N., R. 7 E.

Properties of Folds	Pink Limestone Datum	Arbuckle Group Datum
Number of control points	15	12
Controlled closure (ft)	140	300
Areas within lowest closed contour line	Approx. 1080	Approx. 1840
Length-width ratio, middle closed contour line	1.1:1	1.1:1
Displacement of axial position on Arbuckle datum cf. position on Pink datum	No significant displacement	No significant displacement
Average dips on flanks (degrees)	N 2.3 S 2.0 E 2.5 W 2.2	N 3.6 S 3.6 E 3.3 W 3.3
Orientation of axis	Domal	Domal

Note: Data shown here were compiled from maps shown in Fig. 8. At the level of the Arbuckle, the Boston dome is almost twice as large (planimetrically) as it is at the level of the Pink Limestone. Moreover, closure at the top of the Arbuckle is about twice as much as on the Pink Limestone. Dips on the Pink Limestone are about half as steep as those on the Arbuckle. Length-width ratios indicate that the dome retains its basic planimetric form from the level of the Arbuckle to the Pink Limestone.



BUELL FIELD
(T23N-R9E)

Fig. 9.-Structural geology of Buell Field, at the levels of the Pink Limestone and the Arbuckle Group

TABLE II

SUMMARY STATISTICS, STRUCTURAL GEOLOGY OF BUELL FIELD, SEC. 27-29, T. 23 N., R. 9 E.

Properties of Folds	Pink Limestone Datum	Arbuckle Group Datum
Number of control points	20	6
Controlled closure (ft)	20	40
Acres within lowest closed contour line	Approx. 80	Approx. 160
Length-width ratio, middle closed contour line	1.2:1	1.1:1
Displacement of axial position on Arbuckle datum cf. position on Pink datum	Arbuckle displaced approximately 300 ft northwestward	
Average dips on flanks (degrees)	N 2.0 S 1.4 E 1.4 W 1.2	N 2.0 S 1.4 E 1.6 W 1.6
Orientation of axis	Domal; slightly, northeastward	Domal; slightly, northwestward

Note: Data shown here were compiled from maps shown in Fig. 9. At the level of the Arbuckle, the Buell Field is almost twice as large (planimetrically) as it is at the level of the Pink Limestone. Moreover, closure at the top of the Arbuckle is about twice as much on the Pink Limestone. Dips at the Arbuckle level are maximally 1.2 times as steep as on the Pink Limestone. The fold effectively is domal being displaced approximately 300 ft northwestward at the Arbuckle level.

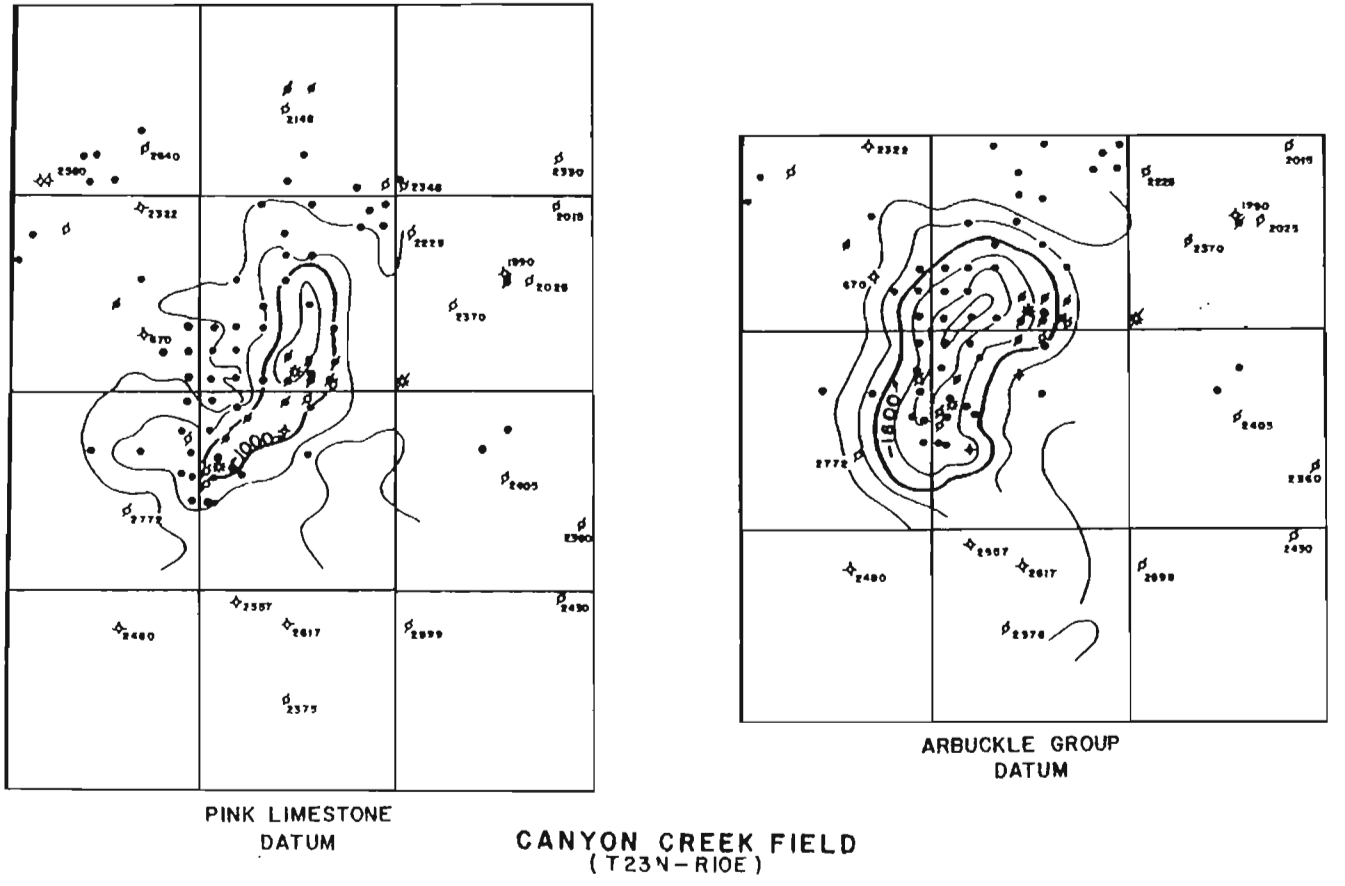


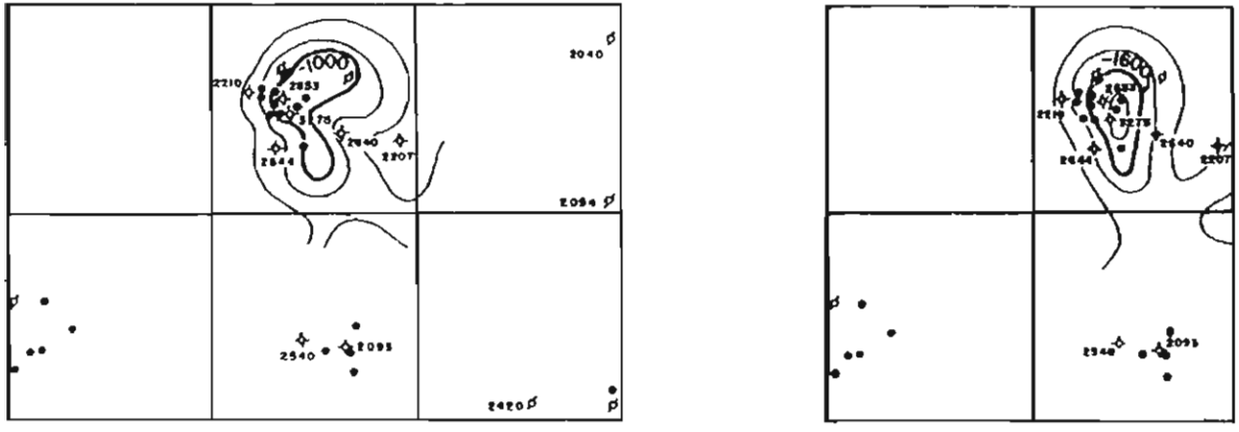
Fig. 10.-Structural geology of Canyon Creek Field, at the levels of the Pink Limestone and the Arbuckle Group

TABLE III

SUMMARY STATISTICS, STRUCTURAL GEOLOGY OF
CANYON CREEK FIELD, SEC. 17,
T. 23 N., R. 10 E.

Properties of Folds	Pink Limestone Datum	Arbuckle Group Datum
Number of control points	25	8
Controlled closure (ft)	60	80
Acres within lowest closed contour line	Approx. 560	Approx. 480
Length-width ratio, middle closed contour line	3.9:1	5.5:1
Displacement of axial position on Arbuckle datum cf. position on Pink datum	Axis on top Arbuckle Group about 700 ft west of axis on Pink Limestone	
Average dips on flanks (degrees)	NE 2.9 E 2.5 SE 1.7 NW 2.2 W 2.9 SW 1.7	NE 2.2 E 2.8 SE 2.6 NW 2.9 W 2.5 SW 2.3
Orientation of axis	Northward	Northward to northeastward

Note: Data shown here were compiled from maps shown in Fig. 10. At the level of the Arbuckle, closure is about 1.3 times as much as closure at the level of the Pink Limestone, and the fold is about 0.9 as large. Dips at the level of the Arbuckle are maximally about 1.3 times as steep as on the Pink Limestone. The fold effectively is a north-trending anticline displaced about 700 ft west of the Pink Limestone axis at the Arbuckle level.



PINK LIMESTONE DATUM

ARBUCKLE GROUP DATUM

SOUTH CANYON CREEK FIELD

(T23N—R10E)

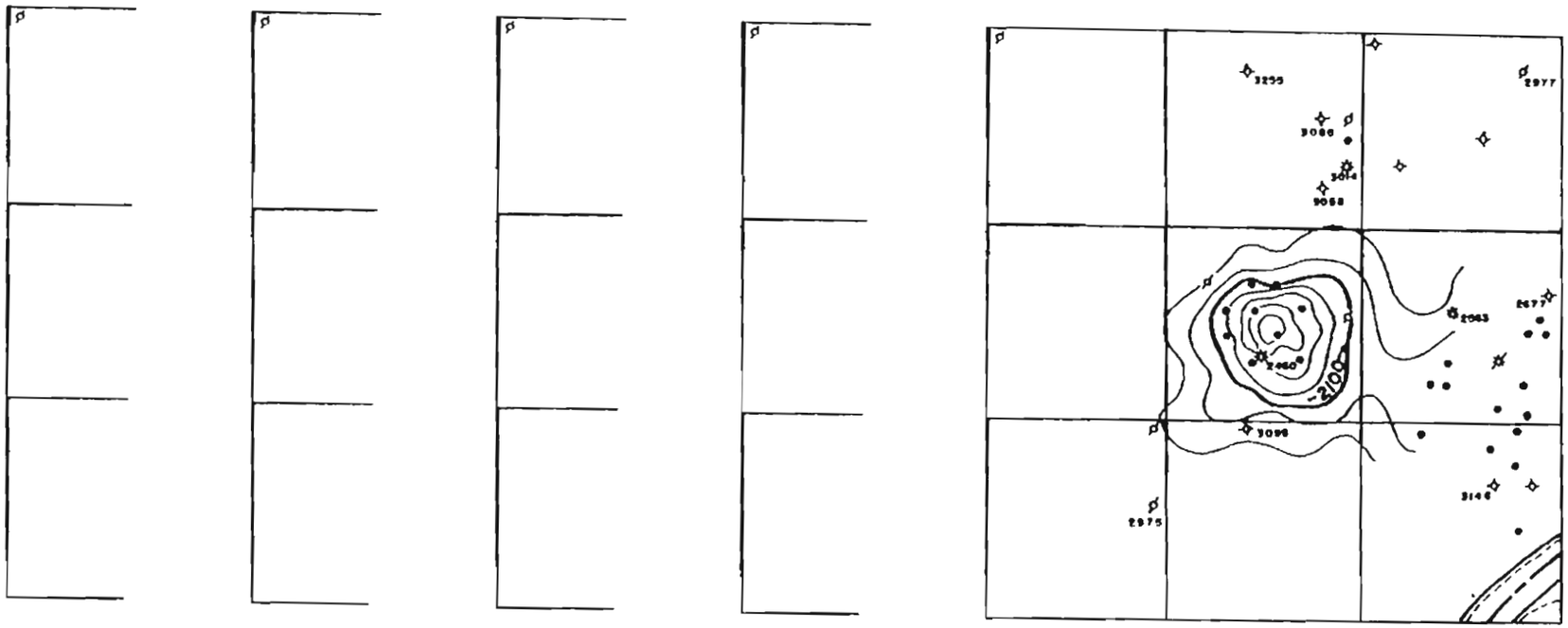
Fig. 11.-Structural geology of South Canyon Creek Field, at the levels of the Pink Limestone and the Arbuckle Group

TABLE IV

SUMMARY STATISTICS, STRUCTURAL GEOLOGY OF
SOUTH CANYON CREEK FIELD, SEC. 32,
T. 23 N., R. 10 E.

Properties of Folds	Pink Limestone Datum	Arbuckle Group Datum
Number of control points	5	4
Controlled closure (ft)	60	60
Acres within lowest closed contour line	Approx. 160	Approx. 160
Length-width ratio, middle closed contour line	2.1:1	1.7:1
Displacement of axial position on Arbuckle datum cf. position on Pink datum	No significant displacement	No significant displacement
Average dips on flanks (degrees)	NE 1.7 E 2.9 SE 1.7 NW 2.9 W 2.9 SW 2.2	NE 2.6 E 3.4 SE 2.9 NW 2.9 W 2.6 SW 2.6
Orientation of axis	Northward	Northward

Note: Data shown here were compiled from maps shown in Fig. 11. At the level of the Arbuckle, closure is essentially equivalent to closure at the Pink Limestone level, and the areal size is also equivalent. Dips at the Arbuckle level are maximally about 1.5 times as much as at the Pink Limestone. The fold is a north-trending anticline.



D_ACKBURN FIELD_ACKBURN FIELD_ACKBURN FIELD_ACKBURN FIELD_ACKBURN FIELD

22N-R7E) 22N-R7E) 22N-R7E) 22N-R7E) 22N-R7E)

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l: Limestone and: Limestone and: Limestone and: Limestone and: Limestone and the Arbuckle Group

TABLE V

SUMMARY STATISTICS, STRUCTURAL GEOLOGY OF
NORTH BLACKBURN FIELD, SEC. 5,
T. 22 N., R. 7 E.

Properties of Folds	Pink Limestone Datum	Arbuckle Group Datum
Number of control points	12	7
Controlled closure (ft)	60	80
Acres within lowest closed contour line	Approx. 280	Approx. 340
Length-width ratio, middle closed contour line	1.3:1	1:1
Displacement of axial position on Arbuckle datum cf. position on Pink datum	No significant displacement	No significant displacement
Average dips on flanks (degrees)	N 1.6 S 1.1 E 2.0 W 2.1	N 3.3 S 2.5 E 2.3 W 2.5
Orientation of axis	Domal	Domal

Note: Data shown here were compiled from maps shown in Fig. 12. At the level of the Arbuckle, closure is about 1.3 times as much as at the level of the Pink Limestone, and the dome is about 1.2 times as large in areal extent. Dips at the level of the Arbuckle are maximally about twice as steep as on the Pink Limestone. The fold effectively is domal at both levels.

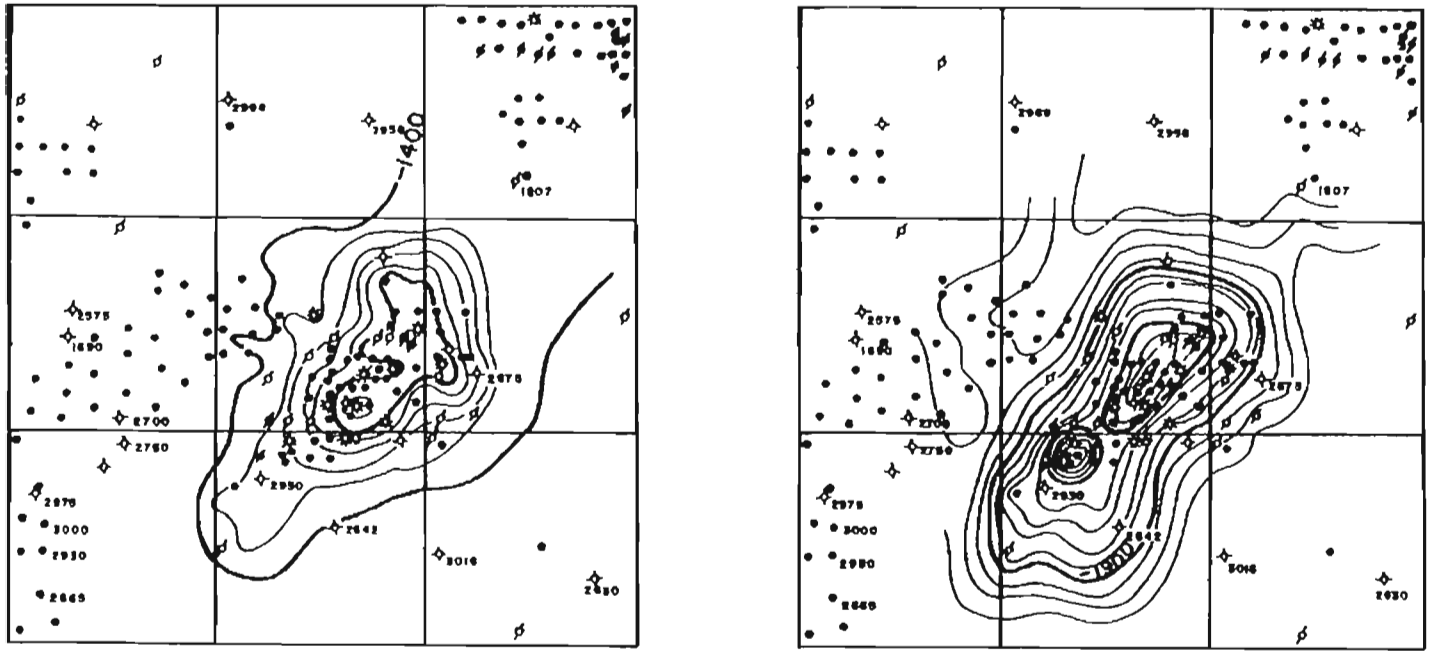


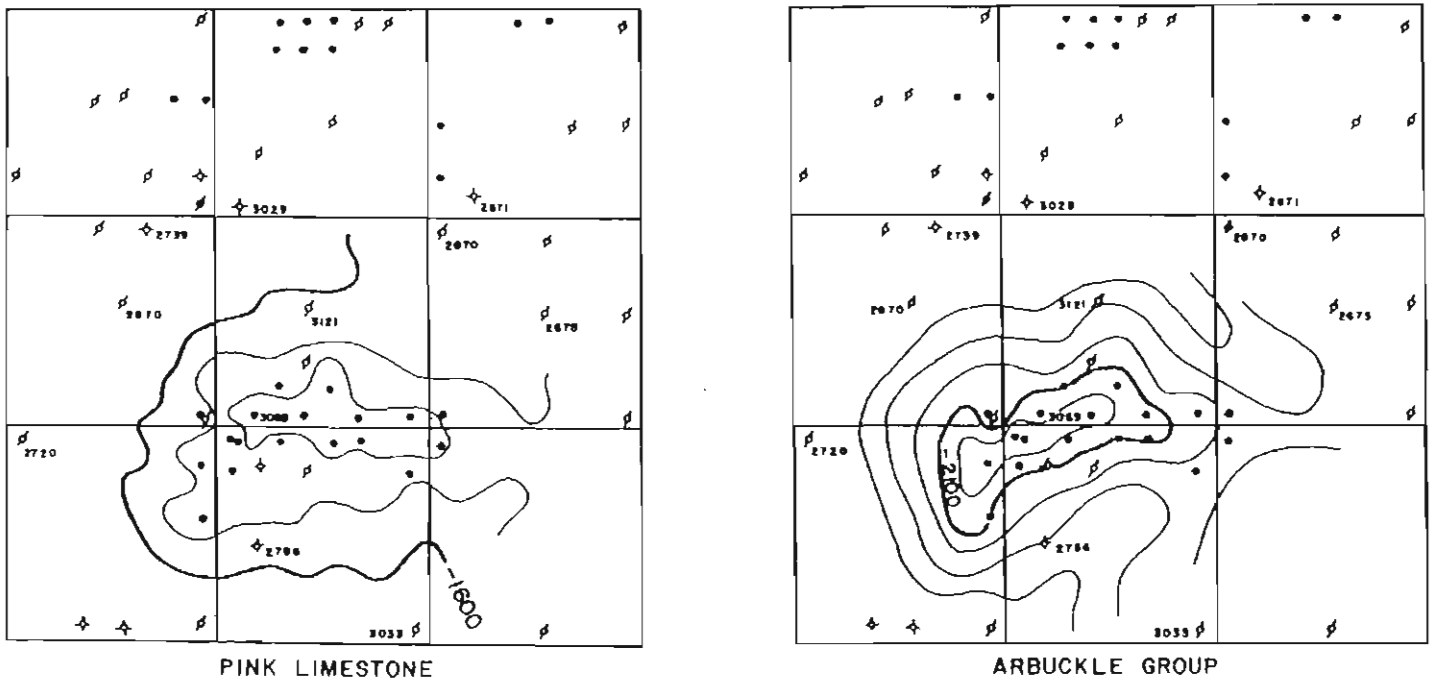
Fig. 13.-Structural geology of Pettit Field, at the levels of the Pink Limestone and the Arbuckle Group

TABLE VI

SUMMARY STATISTICS, STRUCTURAL GEOLOGY OF
PETTIT FIELD, SEC. 20 AND 29,
T. 23 N., R. 8 E.

Properties of Folds	Pink Limestone Datum	Arbuckle Group Datum
Number of control points	12	8
Controlled closure (ft)	120	200
Acres within lowest closed contour line	Approx. 340	Approx. 920
Length-width ratio, middle closed contour line	1.9:1	4.0:1
Displacement of axial position on Arbuckle datum cf. position on Pink datum	No significant displacement	No significant displacement
Average dips on flanks (degrees)	NW 2.0 E 2.1 SE 2.1 NW 6.9 W 3.4 SW 3.4	NE 2.0 E 3.6 SE 3.2 NW 5.2 W 4.8 SW 3.6
Orientation of axis	Northeastward	Northeastward

Note: Data shown here were compiled from maps shown in Fig. 13. At the level of the Arbuckle, closure is about 1.7 as much as at the level of the Pink Limestone, and the areal extent is about 2.7 times as large. Dips at the level of the Arbuckle are maximally about 1.7 times as steep as on the Pink Limestone. The fold effectively is anticlinal, trending northeastward, with the axial position showing no significant displacement with depth.



SOUTH NAVAL RESERVE FIELD

(T 23 N - R 7 E)

Fig. 14.-Structural geology of South Naval Reserve Field, at the levels of the Pink Limestone and the Arbuckle Group

TABLE VII

SUMMARY STATISTICS, STRUCTURAL GEOLOGY OF SOUTH NAVAL RESERVE FIELD, SEC. 9, 16, AND 17, T. 23 N., R. 7 E.

Properties of Folds	Pink Limestone Datum	Arbuckle Group Datum
Number of control points	13	7
Controlled closure (ft)	20	40
Acres within lowest closed contour line	Approx. 240	Approx. 320
Length-width ratio, middle closed contour line	2.7:1	2.3:1
Displacement of axial position on Arbuckle datum cf. position on Pink datum	Slight displacement at top of Arbuckle of approximately 300 ft to west-southwest	
Average dips on flanks	NE 1.1 E 0.4 SE 1.0 NW 1.1 W 0.5 SW 1.4	NE 1.1 E 0.1 SE 1.1 NW 1.1 W 1.4 SW 1.3
Orientation of axis	Eastward	West-southwestward

Note: Data shown here were compiled from maps shown in Fig. 14. At the level of the Arbuckle, closure is about twice as much as at the level of the Pink Limestone; the anticline structure is about 1.3 times as large in areal extent. Dips at the level of the Arbuckle are maximally about 2.8 times as steep as on the Pink Limestone. The fold is an anticline that trends generally eastward. The axis at the Arbuckle datum is displaced 300 ft to the west-southwest of the axis at the Pink Limestone.

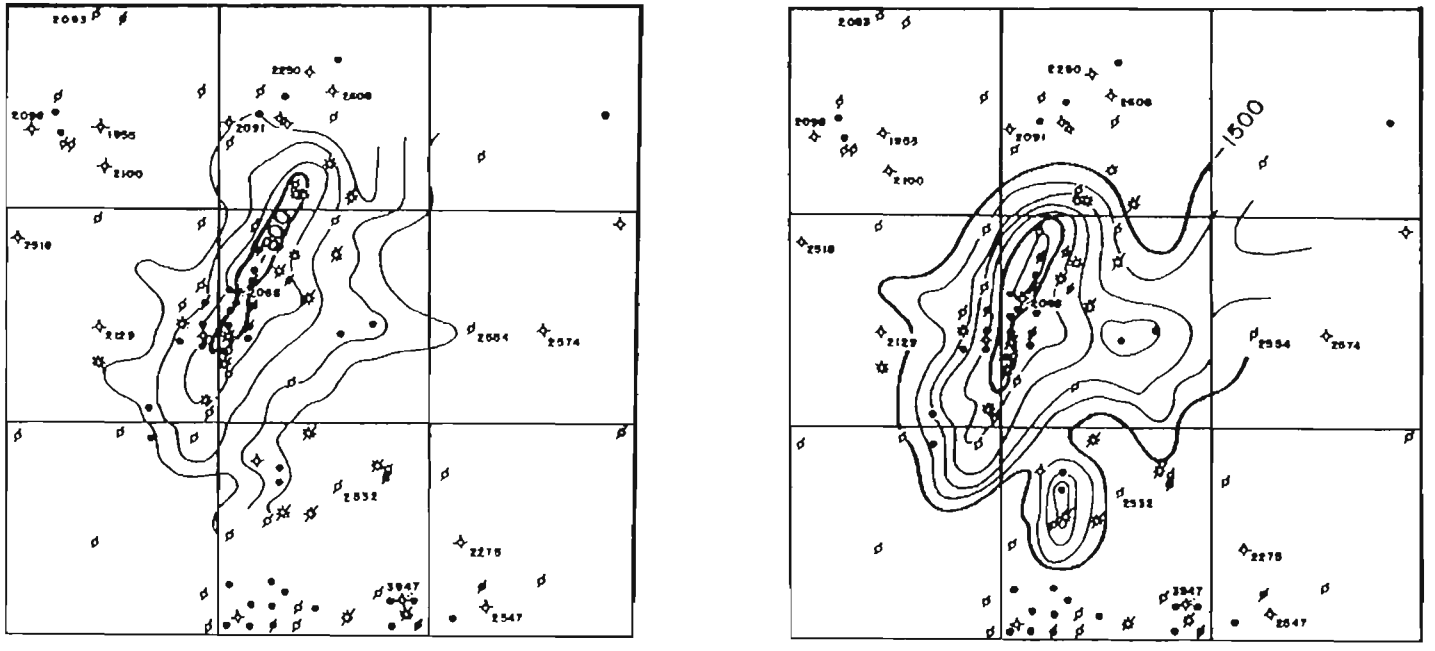


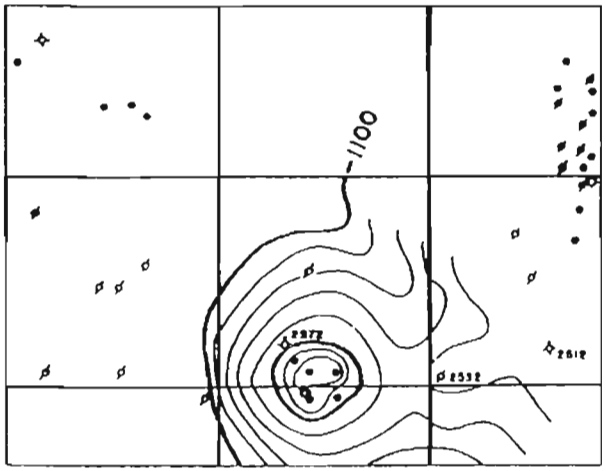
Fig. 15.-Structural geology of South Wildhorse Field, at the levels of the Pink Limestone and the Arbuckle Group

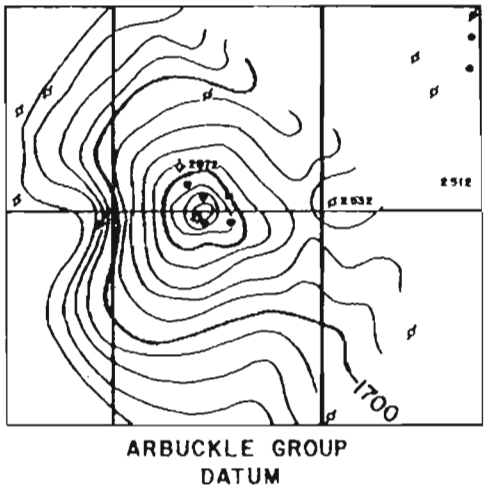
TABLE VIII

SUMMARY STATISTICS, STRUCTURAL GEOLOGY OF
SOUTH WILDHORSE FIELD, SEC. 11 AND 12,
T. 21 N., R. 10 E.

Properties of Folds	Pink Limestone Datum	Arbuckle Group Datum
Number of control points	14	8
Controlled closure (ft)	40	80
Acres within lowest closed contour line	Approx. 440	Approx. 400
Length-width ratio, middle closed contour line	4.6:1	3.3:1
Displacement of axial position on Arbuckle datum cf. position on Pink datum	No significant displacement	No significant displacement
Average dips on flanks (degrees)	NE 1.7 E 1.2 SE 1.2 NW 2.3 W 2.3 SW 1.3	NE 2.9 E 3.9 SE 2.0 NW 3.9 W 3.9 SW 2.6
Orientation of axis	North-northeastward	North-northeastward

Note: Data shown here were compiled from maps shown in Fig. 15. At the level of the Arbuckle, closure is twice as much as closure at the level of the Pink Limestone, and the anticline is 0.9 times as large in areal extent. Dips on the Arbuckle are maximally about 3.2 times as steep as on the Pink Limestone. The anticline trends north-northeastward with no significant displacement at depth.





WEST WILDHORSE FIELD

(T22N—R9E)

Fig. 16.-Structural geology of West Wildhorse Field, at the levels of the Pink Limestone and the Arbuckle Group

TABLE IX

SUMMARY STATISTICS, STRUCTURAL GEOLOGY OF
WEST WILDHORSE FIELD, SEC. 24 AND 25,
T. 22 N., R. 9 E.

Properties of Folds	Pink Limestone Datum	Arbuckle Group Datum
Number of control points	3	6
Controlled closure (ft)	60	100
Acres within lowest closed contour line	Approx. 160	Approx. 280
Length-width ratio, middle closed contour line	1.1:1	1:8
Displacement of axial position on Arbuckle datum cf. position on Pink datum	No significant displacement	No significant displacement
Average dips on flanks (degrees)	N 2.5 S 2.1 E 2.0 W 1.7	N 3.6 S 3.2 E 2.6 W 4.0
Orientation of axis	Domal	Domal

Note: Data shown here were compiled from maps shown in Fig. 16. At the level of the Arbuckle, closure is about 1.7 times as much as closure at the level of the Pink Limestone; the dome is about 1.8 times as large in areal extent. Dips at the level of the Arbuckle are maximally about 2.3 times as steep as on the Pink Limestone. The crest of the dome shows no significant displacement with depth.

In summary, only small displacements of crests of the structures were recorded. In general, length-width ratios are smaller at the Arbuckle datum than at the Pink datum.

Evolution of Folds

Folds within the study area developed in several episodes. Plates 3 and 4 show evidence of pre-Mississippian folding. For example, evidence of incremental structural development can be seen by comparison of two wells in the Terlton Field (Sec. 6, T. 20 N., R. 8 E.) and (Sec. 1, T. 20 N., R. 7 E.) (Pl. 3 and 4).

With regard to the well in the C SW NW Sec. 6, T. 20 N., R. 8 E., thickness of the section between the top of the Arbuckle and the base of the Mississippian is 120 ft; thickness of the section between the top of the Arbuckle and top of the Pink Limestone is 316 ft (Pl. 3 and 4). In the well in the C NE SW Sec. 1, T. 20 N., R. 7 E., thickness between the top of the Arbuckle and base of the Mississippian is 234 ft, whereas thickness between the top of the Arbuckle and the base of the Pink Limestone is 554 ft (Pl. 3 and 4). Between these two wells there is a difference of 185 ft from the base of the Mississippian to the top of the Arbuckle Group and 114 ft from the base of the Mississippian to the top of the Pink Limestone. This results in 71 ft more structural difference at the Arbuckle level in the well in Sec. 6, T. 20 N., R. 8 E. with relation to the well in Sec. 1, T. 20 N., R. 7 E. Using the data from the Terlton Field, folding in Sec. 6, T. 20 N., R. 8 E. appears to have taken place originally during the Ordovician or later during pre-Mississippian time. Folding again took place during the Mississippian, Pennsylvanian and later, to obtain the present

structural configuration.

The South Hominy Lake Field (Sec. 9, 10 and 15, T. 22 N., R. 8 E.) also shows evidence of long-term growth of structures (Pl. 3 and 4). At the Arbuckle level this field is divided by a fault trending east-northeastward (Pl. 2). At the level of the Pink Limestone, the structure is domal, and no evidence of faulting is recorded. The isopachous maps (Pl. 3 and 4) indicate that the rock section thins over the field, and the greater amount of thinning is in the Arbuckle-to-base Mississippian section. Close inspection of the electrical logs on the upthrown and downthrown blocks of the fault at the Arbuckle level reveal that all the units present on the downthrown side of the fault are present in the upthrown side, but each unit on the upthrown side shows a shortened section. This shortened section can be found to extend through the Pennsylvanian section (Pl. 12). This evidence suggests that the South Hominy Lake Field has "grown" more-or-less continuously from pre-Mississippian time to Late Pennsylvanian time.

Structural contour maps on top of the Arbuckle Group (Pl. 2) and on top of the Pink Limestone (Pl. 1) were the basis for estimation of the general configuration of the Arbuckle Group. These maps were used with isopachous maps of the Pink Limestone (top)-to-Arbuckle interval and of the Woodford Shale (top)-to-Arbuckle interval (Pl. 3, 4). When compared to structural contour maps, these isopachous maps generally show that the pre-Mississippian section thins across the crests of present-day anticlines and domes.

Thinning of the Arbuckle-Mississippian section would not be present unless the positive structural features had been in existence prior to deposition of pre-Mississippian sediments. Thinning of the

Pink-to-Mississippian section indicates that the fold was present during deposition of these strata. Beds that show thinning over the folds record long-term growth, long-term differential compaction, or both. Areas on the isopachous maps (Pl. 3 and 4) where thinning coincides with structural closure at the Arbuckle level (Pl. 2) are at these oil fields: Wildhorse, Sec. 32-34, T. 22 N., R. 10 E.; Osage-Hominy, Sec. 8, 9, and 16, T. 23 N., R. 8 E.; Boston, Sec. 1, T. 22 N., R. 7 E.; South Hominy Lake, Sec. 10 and 15, T. 22 N., R. 8 E.; Cleveland, Sec. 17-21, 29 and 30, T. 20 N., R. 8 E.; and Madalene, Sec. 16 and 17, T. 21 N., R. 10 E.

CHAPTER IV

STRATIGRAPHY

Regional Stratigraphy, Arbuckle Group

In northeastern Oklahoma the Arbuckle Group includes mostly carbonate rocks with some sandstones and shales, all older than the Simpson Group and younger than the Lamotte Sandstone (Fig. 5) (Reeder, 1974). The formal stratigraphic nomenclature is based upon the work of McCracken (1964) with regard to the type section in Missouri. Major unconformities are at the base and top of the Arbuckle Group with evidence of six disconformities inside the Arbuckle (Reeder, 1974). Due to lithic similarity of beds within the Arbuckle, correlation of stratigraphic units from surface to subsurface is difficult.

In northeastern Oklahoma, the Arbuckle Group is made up of seven formations (Fig. 5). In ascending order these are the Bonneterre Dolomite, Eminence Dolomite, Gasconade Formation, Roubidoux Formation, Jefferson City Dolomite, Cotter Dolomite and Powell Dolomite.

Local Stratigraphy, Arbuckle Group

Lithology of Arbuckle Rocks

In the study area the Arbuckle was divided into *ad hoc* lithostratigraphic units. These units were defined and described from bit cuttings, chip logs, and correlation cross sections that integrated

evidence from inspection of samples, from chip logs, and from wire-line logs. In general, the Arbuckle is made up of limestones, dolomitic limestone, dolomites, and calcareous dolomites interbedded with several sandstones and shales that are marked beds in some parts of the study area. These provisional lithostratigraphic units are designated as units A through G, in descending stratigraphic order. Descriptions of these units follow; correlations are shown on Plates 6 through 12.

Unit A. Brown, very finely to finely crystalline dolomitic limestone that grades into light gray to brown slightly siliceous or cherty dolomite. Porosity is pinpoint and primary intercrystalline or vuggy; some of the vugs are not connected. Thin beds of green shale are in unit A at some localities.

Unit B. Dark brown to gray, very finely crystalline dolomite that is slightly calcareous. The unit contains beds of chert at some places. Porosity is poor to absent. The lower part of unit B is slightly coarsely crystalline with little or no visible porosity. A green-gray and black shale underlies unit B.

Unit C. Tan, white, or gray dolomite and dolomitic limestone interbedded with chert. Also within this lithostratigraphic unit are beds of gray and green shale and a dolomite that contains well rounded grains of quartz.

Unit D. Dolomitic limestones and dolomite. Several beds of chert are contained in the limestones and dolomites. Green, gray and black shales are included at some localities. Some of the black and gray shales contain pyrite. Porosity does not occur everywhere in the

unit, but ranges from poor to fair at some localities. Porosity is intercrystalline and vuggy.

Unit E. Dolomite that commonly contains chert. The chert varies from brown and gray cryptocrystalline, tripolitic chert to tan and white oolitic chert. The dolomites are siliceous to calcareous and pyritic. Iron oxide stains fracture faces and at some places is incorporated within the matrix of the rock. Within unit E also are several gray and black shale beds ranging in thickness from about 2 to about 10 ft. As this unit is correlated to the eastern portion of the study area, it thins slightly, owing to thinning of the shales.

Unit F. Calcareous dolomite and dolomite that contain bedded chert and sandstone. The dolomites generally are finely crystalline, but some are slightly coarsely crystalline and some are almost sucrosic. The slightly crystalline dolomites commonly show fair porosity. Cherts range from gray to mottled and varicolored. Sandstones are quartzose with medium to large grains.

Unit G. The base of unit G overlies the Reagan Sandstone or the Precambrian. The upper half of this unit consists of dolomite and calcareous dolomite with quartzose sandstone, dolomitic sandstone and chert; the chert is disseminated or laminated within the dolomite beds. Dolomites are very finely crystalline to finely crystalline with little or no porosity. They are slightly fossiliferous in some places. Crinoid and brachiopod fragments, as well as some unrecognizable fossil fragments, are contained. Dolomitization of these fragments has altered many of their small-scale characteristics. Sand grains are more angular toward the base of the unit. The lowermost portion of

unit G is gray, finely crystalline to dense dolomite with fragments of sandstone, chert, green shale and pink granite. These ad hoc units are not recorded throughout the entire study area. The lower beds of unit G wedge out against the Precambrian paleotopographic highs more commonly than any of the other ad hoc units. Examples can be found at Pettit Field (Sec. 20, 29, T. 23 N., R. 8 E.), Osage-Hominy Field (Sec. 9, T. 23 N., R. 8 E.), and Wildhorse Field (Sec. 32, T. 22 N., R. 10 E.) (Fig. 2).

Correlation of Units Within the Arbuckle

Correlation within the Arbuckle Group by use of electrical logs and induction-electrical logs commonly is difficult. Of course, such logs are far more useful when combined with sample logs made from descriptions of bit cuttings. By attaching cuttings to the median part of the log from which they were derived, rock chips and log curves can be inspected concurrently, and correlation can be developed. By this method, units within the Arbuckle have been correlated across the study area (Pl. 6-12). Often the most apparent rock properties, such as color, enable one to make basic correlations even without the aid of microscopic examination.

CHAPTER V

PETROLEUM GEOLOGY

In the study area, the Arbuckle Group produces in several oil and gas fields (Pl. 5). Some of the more productive fields are South Canyon Creek, West Wildhorse, Boston and North Enterprise (Fig. 2). (However, some of the production in these fields has come from formations other than Arbuckle; separation of total production is not possible with the data at hand.) Table X shows the cumulative production through December 1976 or December 1977 as indicated. In 1978, Nadel and Gussman discovered an Arbuckle oil field in the SW, Sec. 12 and NE, Sec. 13, T. 22 N., R 7 E. Cumulative production for this field has not become available.

History of Arbuckle Development

Arbuckle production was discovered first by random drilling in the early 1900's, when very little geologic knowledge was taken into account in exploration. Most of the operators were independent, and many had no background in exploration for hydrocarbons. As more geologic knowledge was put to use, prospecting for the Arbuckle was confined to drilling on domes and anticlines. Normally only the upper portion of the Arbuckle was penetrated, due to the belief that if production could not be found in the uppermost unit then the total formation was to be considered nonproductive. This assumption evolved by experience with

TABLE X

CUMULATIVE PRODUCTION, FIELDS THAT PRODUCE FROM THE ARBUCKLE GROUP, AS OF JANUARY, 1978

Field Name	Location	No. Wells Producing	Year Discovered	Cumulative Production		Field Status
Barker	SE 1-23N-7E	10	1935	49,997,130	12-76*	Active
Barker	SW 1-23N-7E	5	1935	180,882	12-76*	Active
Barker	SE 11-23N-7E	3	1935	64,295	12-76*	P.A.**
Barker	NW 12-23N-7E	13	1935	605,672	12-76*	Active
Barker	NE 12-23N-7E	7	1935	207,391	12-76*	Active
Barker	NW 13-23N-7E	2	1952	38,122	12-75	Active
S. Naval Reserve	SW 9-23N-7E	3	1938	181,362	12-76*	Active
S. Naval Reserve	SE 9-23N-7E	3	1938	445,256	12-76*	Active
S. Naval Reserve	NW 16-23N-7E	4	1938	152,001	12-76*	P.A.
S. Naval Reserve	NE 17-23N-7E	2	1938	141,201	12-76*	P.A.
Enterprise	NW 20-23N-7E	1	1968	40,701	12-76	P.A.
Gilliland	NW 23-23N-7E	11	1951	303,490	12-76*	P.A.
Gilliland	SW 23-23N-7E	14	1951	657,478	12-76*	P.A.
Gilliland	SE 23-23N-7E	3	1951	75,526	12-76*	P.A.
Gilliland	SE 25-23N-7E	6	1919	106,538	12-76*	P.A.
Gilliland	SW 25-23N-7E	5	1919	221,679	12-76*	P.A.
Gilliland	SE 26-23N-7E	23	1919	991,192	12-76*	P.A.
Gilliland	NW 36-23N-7E	5	1919	244,104	12-76*	P.A.
Gilliland	SE 36-23N-7E	10	1919	610,488	12-76*	P.A.
Tidal-Osage	SE 3-23N-8E	6	1951	49,051	12-76*	Active
Osage-Hominy	Union Waterflood Unit Sec. 5,6,7,8,9 N½ 16, N/2 17, N/2 18 23N-8E	217	1917	24,259,647	12-77*	Active
Pettit	SW 20-23N-8E	24	1917	4,116,574	12-76*	Active
Pettit	NW 29-23N-8E	2	1964	132,328	12-77	Active
Gilliland	NW 30-23N-8E	3	1919	43,068	12-76*	Active
Gilliland	SW 30-23N-8E	5	1919	84,837	12-76*	Active

TABLE X (Continued)

Field Name	Location	No. Wells Producing	Year Discovered	Cumulative Production		Field Status
Penn Creek	NE 33-23N-8E	4	1956	190,489	12-76*	P.A.
Penn Creek	SE 33-23N-8E	2	1956	67,482	12-76*	P.A.
Penn Creek	SW 34-23N-8E	1	1970	29,738	12-76	P.A.
Penn Creek	NW 34-23N-8E	6	1922	621,626	12-76*	P.A.
Manion	NW NW SE SW 12-23N-9E	1	1977	937	11-77/ 12-77	P.A.
Manion	SW 10-23N-9E	23	1918	330,823	12-76*	P.A.
Signal Hills	NW 21-23N-9E	6	1944	34,132	12-76*	P.A.
Buell	SW 27-23N-9E	7	1976		*	New
Buell	SE 28-23N-9E	5	1976		*	New
Buell	SE 29-23N-9E	7	1922	232,822	12-76*	P.A.
Lone Springs East	SE 7-23N-10E	2	1951	9,739	12-76*	P.A.
Lone Springs East	SW 7-23N-10E	3	1951	17,268	12-76*	P.A.
Canyon Creek	SE 17-23N-10E	8	1923	405,041	12-76*	Active
Canyon Creek	SW 17-23N-10E	13	1923	214,380	12-76*	Active
South Canyon Creek	SW 32-23N-10E	4	1958	79,988	12-76*	P.A.
South Gilliland	SW 1-22N-7E	2	1977	14,843	12-77	New
South Gilliland	SE 2-22N-7E	6	1957	106,519	12-77*	Active
South Gilliland	NW 2-22N-7E	5	1945	53,049	12-76*	Active
NE Blackburn	SE 4-22N-7E	5	1955	116,793	12-77*	Active
NE Blackburn	NE 9-22N-7E	2	1955	133,858	12-77*	Active
N. Blackburn	NE 5-22N-7E	2	1955	145,740	12-76	Active
N. Blackburn	NW 5-22N-7E	3	1955	224,733	12-76*	Active
N. Blackburn	SE 5-22N-7E	2	1955	98,295	12-76	Active
N. Blackburn	SW 5-22N-7E	3	1955	156,948	12-76	Active
South Gilliland	NE 11-22N-7E	3	1978			New
South Gilliland	SE 11-22N-7E	1	1978			New
South Gilliland	NW 12-22N-7E	2	1978			New

TABLE X (Continued)

Field Name	Location	No. Wells Producing	Year Discovered	Cumulative Production	Field Status
South Gilliland	SE 12-22N-7E	3	1978		New
South Gilliland	NE 13-22N-7E	5	1978		New
Blackburn	21-22N-7E	24	1920	Unitized 6/63 74,302 since unitized*	P.A.
West Boston	SE 34-22N-7E	3	1941	131,447 12-76*	P.A.
Boston	SE 36-22N-7E	15	1912	21,151 12-76*	P.A.
E. Paxton	NE 7-22N-8E	2	1960	14,209 12-76*	P.A.
S. Hominy Lake	NW 9-22N-8E	9	1952	412,976 11-77*	Active
S. Hominy Lake	SW 10-22N-8E	7	1957	72,277 12-77*	Active
S. Hominy Lake	N½ 15-22N-8E	8	1945	424,829 12-77*	Active
Hominy	NW 13-22N-8E	4	1916	1,027,416 12-76*	Active
Black Dog	SW 15-22N-8E	9	1951	865,993 12-76*	Active
W. Black Dog	SE 16-22N-8E	1	1978		New
S. Black Dog	NE 27-22N-8E	6	1955	72,935 12-76*	Active
N. Boston	NW 30-22N-8E	1	1969	21,459 12-77	Active
Flesher	SE 1-22N-9E	12	1930	454,977 12-76*	Active
Sunset	NE 2-22N-9E	3	1954	109,185 12-77	Aban.***
E. Hominy	SW 16-22N-9E	23	1947	443,524 12-76*	P.A.
Hominy	NW 18-22N-9E	10	1916	554,563 12-76*	P.A.
West Wildhorse	SW 24-22N-9E	1	1940	145,397 12-76*	Active
West Wildhorse	SE 24-22N-9E	1	1940	116,371 12-76*	Active
West Wildhorse	NE 25-22N-9E	1	1940	46,414 12-76*	Active
West Wildhorse	NW 25-22N-9E	1	1940	162,158 12-76*	Active
Hominy	NE 28-22N-9E	1	1959	43,381 12-77	Active
South Hominy	NE 29-22N-9E	5	1940	32,584 12-76*	Active
NE Wildhorse	SE 2-22N-10E	5	1952	522,714 12-76*	Active
Wildhorse	SE 32,33,34 Unit	268	1912	15,561,698 12-76*	Active
Boston	NE 1-21N-7E	46	1912	10,399,029 12-76*	Active

TABLE X (Continued)

Field Name	Location	No. Wells Producing	Year Discovered	Cumulative Production		Field Status
Boston	Boston C Unit 1-21N-7E		1974	81,556	1-76	Active
Boston	SW 13-21N-7E	1	1975	9,787	6-76	Active
N. Terlton	SE 25-21N-7E	1	1976	6,589	12-76	Active
N. Terlton	SE 35-21N-7E	11			*	P.A.
E. Osage City	SE 8-21N-9E	1	1970	24,021	11-77	Active
E. Osage City	SW 9-21N-9E	30	1920	667,331	12-76*	Active
E. Osage City	NE 17-21N-9E	5	1970	44,420	12-76	Active
South Wildhorse	NW 11-21N-10E	3	1962	134,164	12-77	Active
South Wildhorse	SW 11-21N-10E	4	1962	295,388	12-76	Active
E. Madalene	NW 14-21N-10E	2	1954	36,336	12-76	P.A.
E. Madalene	NE 23-21N-10E	2	1969	37,609	12-77*	Active
Madalene	NW 17-21N-10E	12	1920	409,331	12-76*	Active
Madalene	NE 18-21N-10E	9	1920	168,292	12-76*	Active
N. Terlton	NW 1-20N-7E	6	1976	6,874	6-76	Active
N. Terlton	NE 2-20N-7E	1	1976	471	7-77	Active
N. Terlton	E½ 6-20N-8E	4	1974	73,009	6-76*	Active

*Unknown amount of production from shallower strata.

**Partially Abandoned.

***Abandoned.

the shallower sandstone formations, in many of which fluids were in communication throughout the rock and formation waters were found below hydrocarbons.

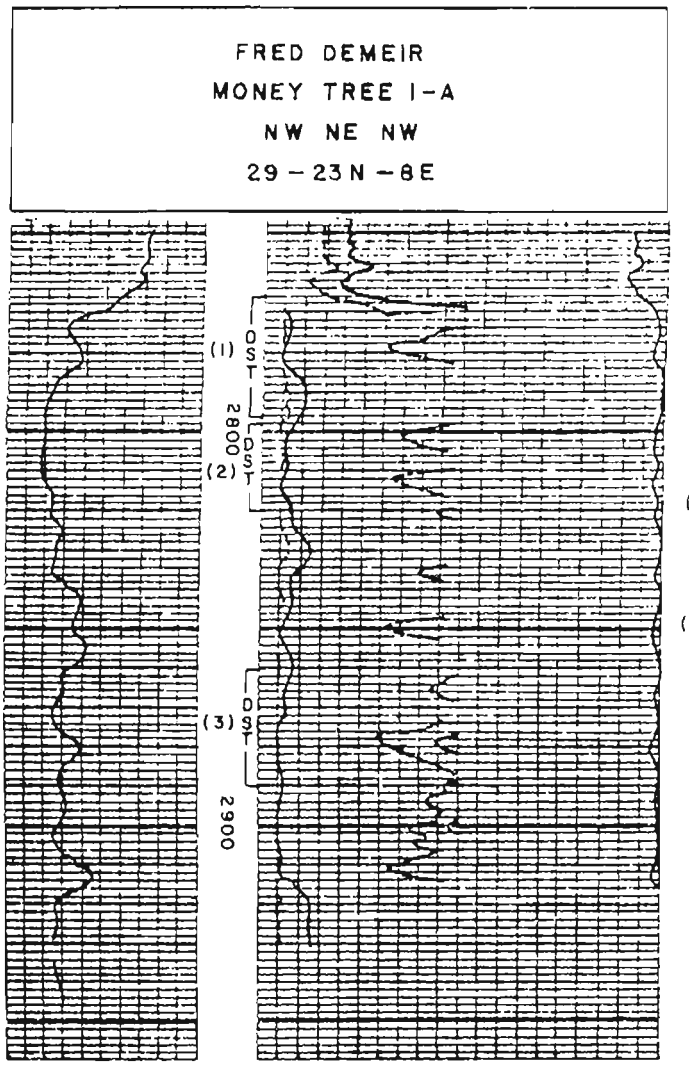
By the late 1950's and the 1960's more wells per year were being drilled through the Arbuckle section to the Precambrian basement than in preceding decades. The Fred DeMier 1-A Money Tree, NW NE NW Sec. 29, T. 23 N., R. 8 E., was such a well (Fig. 17). It established production just 5 ft above the Precambrian. The Harry Davis WS-1, SW Sec. 34, T. 22 N., R. 10 E. was reported to have had shows of oil and gas at considerable depths within the Arbuckle. With the advent of porosity logs and consequent increase in understanding of the variable distribution of porosity in carbonate rocks, drilling into the middle part of the Arbuckle has occurred more frequently.

Traps and Arbuckle Production

In the Arbuckle Group petroleum occurs in traps controlled by (1) faulting, (2) anticlinal folding and domal folding, (3) changes in lithology, and (4) combinations of anticlinal or domal folding and variations in lithology.

Traps Related to Folding

Most of the Arbuckle fields within the study area are related to anticlinal folding. Barker, Blackburn, Boston, Buell, Canyon Creek, South Canyon Creek, Osage-Hominy, Manion, Penn Creek, North Terlton, Wildhorse, and West Wildhorse (Fig. 2 and 16) are some of the fields controlled by folding. In general, production within the study area is developed on anticlines that have at least 20 ft of closure, but this



(1) DST (ARBUCKLE) 2766-2796; OP 2-1/4 HRS, GTS/6 MINS, NO EST., OTS/9 MINS, FLOW 100 BO/2 HRS (INTO TANK) REC. 2796' OIL, IFP 680, FFP 995, SIP 1010/30 MINS

(2) DST (ARBUCKLE) 2798-2820; OP 55 MINS, REC. 1800' MUDDY OIL (50% OIL) 180' SW, IFP 320, FFP 1015, SIP 1015/30 MINS

(3) DST (ARBUCKLE) 2860-2890; OP 15 MINS, GTS/3 MINS, TSTM, OTS/6 MINS, FLOW EST. 250 BOPH, NO WTR, IFP 630, FFP 1280, SIP 1050/30 MINS

Fig. 17.-Fred DeMeir 1-A Money Tree, a well that produced from the upper and lower parts of the Arbuckle

is not the only kind of situation in which the Arbuckle produces from traps related to folding. There are instances in which the Arbuckle produces on anticlinal noses that show no evidence of closure. Fields of this type seem to be due to zones of porous dolomite and limestone that pinch out updip across these anticlinal noses. Examples of fields that produce from anticlinal noses are the Hominy Field, NE SE Sec. 28, T. 22 N., R. 9 E., NE NE SE Sec. 32, T. 23 N., R. 7 E., and SW SW NE Sec. 18, T. 23 N., R. 10 E. (Pl. 2).

Traps Related to Folding and Stratigraphy

The Osage-Hominy Field (Sec. 5-9, 16, 17, 18, T. 23 N., R. 8 E.), the East Osage City Field (Sec. 8, 17, 19, T. 21 N., R. 9 E.) and the Wildhorse Field (Sec. 32-35, T. 22 N., R. 10 E.) (Pl. 2) show evidence of entrapment wherein both structure and stratigraphy are important. Within each of these fields, the Arbuckle is on the flanks of anticlines where younger Paleozoic strata overlie Precambrian rocks in cores of the folds. Pinchouts of the Arbuckle Group result in the formation of traps that primarily are stratigraphic.

The Crown Central Petroleum 31-A, NE NW SE NE Sec. 32, T. 22 N., R. 10 E. is an example of a well in this type of trap. The 31-A penetrated the top of the Arbuckle at 2197 ft and Precambrian rocks at 2215 ft. Thus, the Arbuckle is only 18 ft thick but initially it produced 18 BOPD and 2 MMCFGD.

In the Tidal Osage Oil Company Wildhorse No. 18, C NE and the Wildhorse No. 20, SW SE NE Sec. 32, T. 22 N., R. 10 E., no Arbuckle overlies the Precambrian. This type of pinchout trap could be developed in lower beds of the Arbuckle as well, because, as stated

previously, there is evidence of stratified porosity within the Arbuckle (see Pl. 6).

Stratigraphic Traps

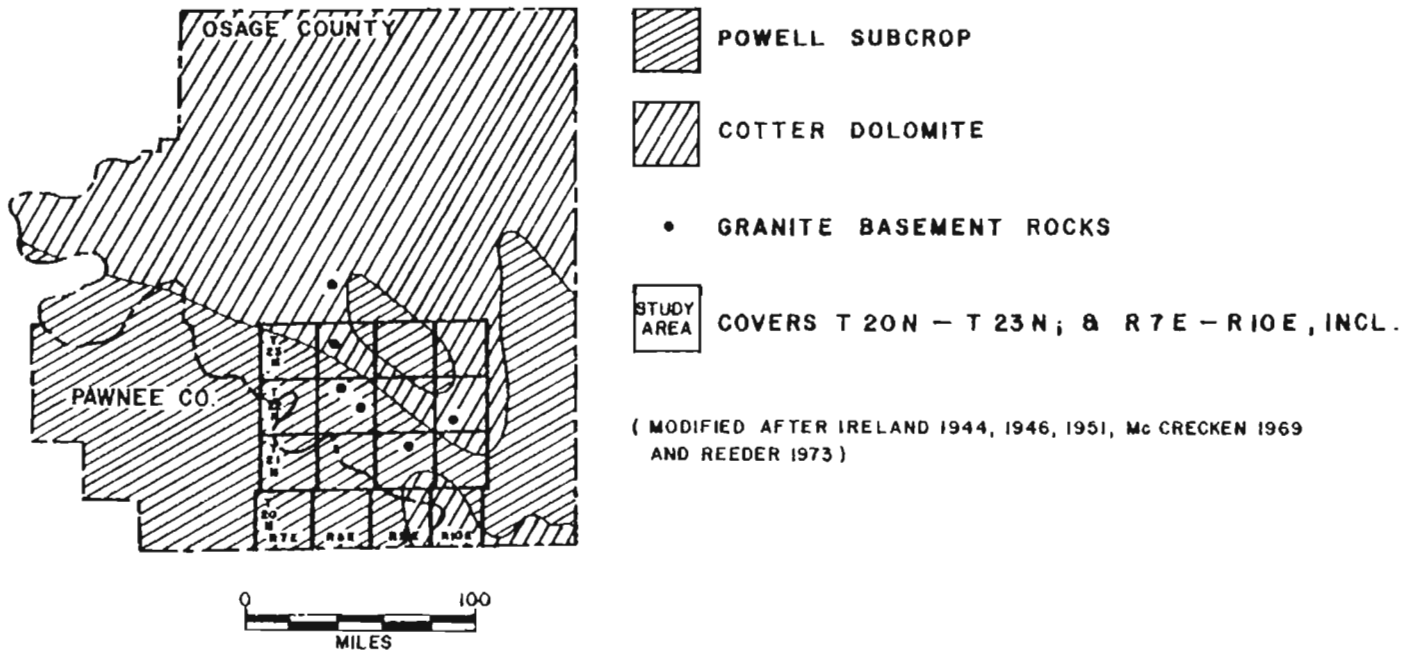
Stratigraphic traps are not readily definable within the Arbuckle Group in the study area. Gamma-ray and porosity logs show that several permeable units thicken, thin and indicate some "pinch out." The Arbuckle Group has several disconformities within it (Chenoweth, 1970), which involve geologic events and conditions that should contribute to the development of stratigraphic traps. Stratigraphic traps should exist in moderately large numbers where the Arbuckle abuts Precambrian highs, resulting in "pinch outs" in dolomite beds.

Another general condition that offers considerable probability of traps is the subcrop of the Powell Dolomite, youngest formation of the Arbuckle Group (Ireland, 1944, 1946, 1951; McCracken, 1964). Along the updip margin of the Powell Dolomite, wedgeout traps could be developed (Fig. 18).

Traps Related to Faulting

Traps in the South Hominy Lake Field, Sec. 10 and 15, T. 22 N., R. 8 E. and in the North Terlton Field, Sec. 6, T. 20 N., R. 8 E. and Sec. 1, T. 20 N., R. 7 E., are related to faulting (Pl. 2).

In both cases, evidence of the faults is shown at the Arbuckle level, but not at the Pink Limestone level. A northeast-trending fault extends through the east side of the North Terlton Field, and a fault is mapped at the crest of the dome in Sec. 6, T. 20 N., R. 8 E. (Pl. 2). It appears, by the production found in the Arbuckle within the



POWELL SUBCROP ACROSS STUDY AREA

Fig. 18.-Subcrop of the Powell Formation beneath the Simpson Group

North Terlton Field, that the fault has established an effective permeability barrier with relation to the migration of hydrocarbons. No hydrocarbon production has been discovered across this fault on its downthrown side.

South Hominy Lake Field is crossed by an east-northeast-trending fault (Pl. 2). This field is uncommon in that the Arbuckle produces both on the updip and downdip sides of the fault. Isopachous maps of the intervals from the tops of the Pink Limestone and Woodford Shale to the top of the Arbuckle Group show significant thinning on the north side of the fault. Essentially the entire stratigraphic section north of the fault is present, but thin. On the south side of the fault, the stratigraphic section shows normal thickness. Thinning of the formations on the northern, upthrown side of the fault indicates intermittent deformation from the Ordovician into the Pennsylvanian.

Wellsite Evaluation of Rocks of the Arbuckle Group

Drilling-Time Logs

Wellsite evaluation before logging of the Arbuckle should be done in detail in order to detect changes in porosity and in other important lithic properties. Plots of drilling time can be very informative. Logarithmic (base 10) plots of drilling time ordinarily will result in a curve similar to that of the SP curve. Therefore, correlation with nearby wells is made easier.

Careful description of samples as to crystallinity, grain size, color, porosity, accessory lithologies and fossils can be used to distinguish units within the Arbuckle, some of which can be correlated to

other wells. (An example of this is shown in the correlation between the Big Four Bird No. 5, SE NW SW Sec. 33, T. 22 N., R. 7 E. and Sunray Oil Corp. S-3, SW Sec. 34, T. 22 N., R. 10 E. (Pl. 13); this conclusions was based largely upon lithologic characteristics.)

Gamma Ray-Porosity Logs

Gamma ray-porosity logs are the best of the borehole surveys for correlation within the Arbuckle Group. The compensated density log best illustrates the usefulness of porosity plots (Pl. 14). The gamma-ray curve (Pl. 14) is better for definition of individual beds than the SP curve of electrical and induction logs. Bulk-density and other porosity curves generally compliment the gamma-ray curves and thereby contribute to improved correlation. Some beds of dolomite, limestone, and shale can be correlated across long distances by use of the bulk-density and porosity curves (for example see Pl. 6). The sonic and neutron porosity logs are quite useful in correlation in some instances, but configurations of their curves are not as strongly associated with lithologic changes as are curves of density logs.

Kinds of Porosity Within the Arbuckle

Porosity within the Arbuckle is both primary and secondary. Primary porosity is intercrystalline; secondary porosity includes vuggy and fracture porosity. Inspection of bit cuttings reveals that the amount of intercrystalline porosity is related to crystal size and the percentage of pore space present soon after deposition. In some instances, secondary calcite overgrowths on crystalline particles leave slightly coarsely crystalline rock within no effective porosity.

Secondary porosity in the Arbuckle commonly is vuggy. Microscopic evaluation of bit cuttings reveals that many of these vugs contain small calcite or dolomite rhombohedra. Also, minor amount of other minerals, such as pyrite, may be within the linings of vugs.

Fracturing is observed in bit cuttings from the Arbuckle at various stratigraphic positions. Porosity along fractures is enhanced by dissolution along the fracture walls and by dolomitization. However, deposition of secondary calcite within fractures reduces porosity in some instances. Where secondary calcite has crystallized toward the centers of fractures from the fracture walls, detection of fractured porosity in bit cuttings is considerably easier than in fractured rocks where secondary crystals are absent.

Porosity logs can be very helpful in finding trends of porosity within a group of prospective reservoir rocks. Cross-section A-A' (Pl. 6) is a good example of definite zones of porosity that extend over significant distances. A porous unit near the base of the Viking Petroleum Company Boston "D" No. 1, SW NW SE, Sec. 1, T. 21 N., R. 7 E. can be correlated to the Crown Central Petroleum Corporation 31-B, 625 FSL and 2070 FEL, Sec. 32, T. 22 N., R. 10 E. These wells are about 14 mi apart.

Evaluation of Shows of Hydrocarbons

Two methods of estimating the hydrocarbon content of the Arbuckle are available to the wellsite geologist. The first is direct visible evaluation of staining, of hydrocarbon residue within the pore spaces, of fluorescence, and of hydrocarbon "cut," either in chlorothene, carbon tetrachloride, or some other solvent. The second method is

indirect evaluation by drillstem testing. Drillstem testing generally provides valuable information about rock pressures and fluid content within the interval tested. Except for final completion and production testing of wells, it is the best way to evaluate the zones in which hydrocarbon shows are seen in bit cuttings. Examples of drillstem tests in the Arbuckle are shown in Figures 17, and 19-23. These tests were selected because they are believed to be representative samples.

Drillstem testing becomes an important factor in the Arbuckle because facies changes among limestone, dolomite, and chert have various effects on electrical surveys. Resistivity curves may be affected by the chert and high- or low-resistivity beds to give erroneous readings and consequent misinterpretation. Resistivity curves of several of the chert beds within the Arbuckle Group indicate that these rocks generally tend to show relatively low resistivities. If chert, limestone, and dolomite beds have small amounts of porosity but contain a few small fissures, porosity would be low but permeability could be high. The water saturation in such cases would be calculated as being high, whereas upon completion the actual fluids produced may be hydrocarbons drawn from great distances around the borehole. A similar case could be where the resistivity curves of the formation may show exceedingly low values and high porosities are developed. If the calculations are based on erroneous assumptions about the lithology of a formation, the result could be misinterpretation of the data presented by the logs. Calculations of water saturation might indicate that the formation would be nonproductive. Therefore, it is very important that minor constituents of limestones, such as chert, shale, and percentages of calcite, dolomite or quartz, be taken into consideration.

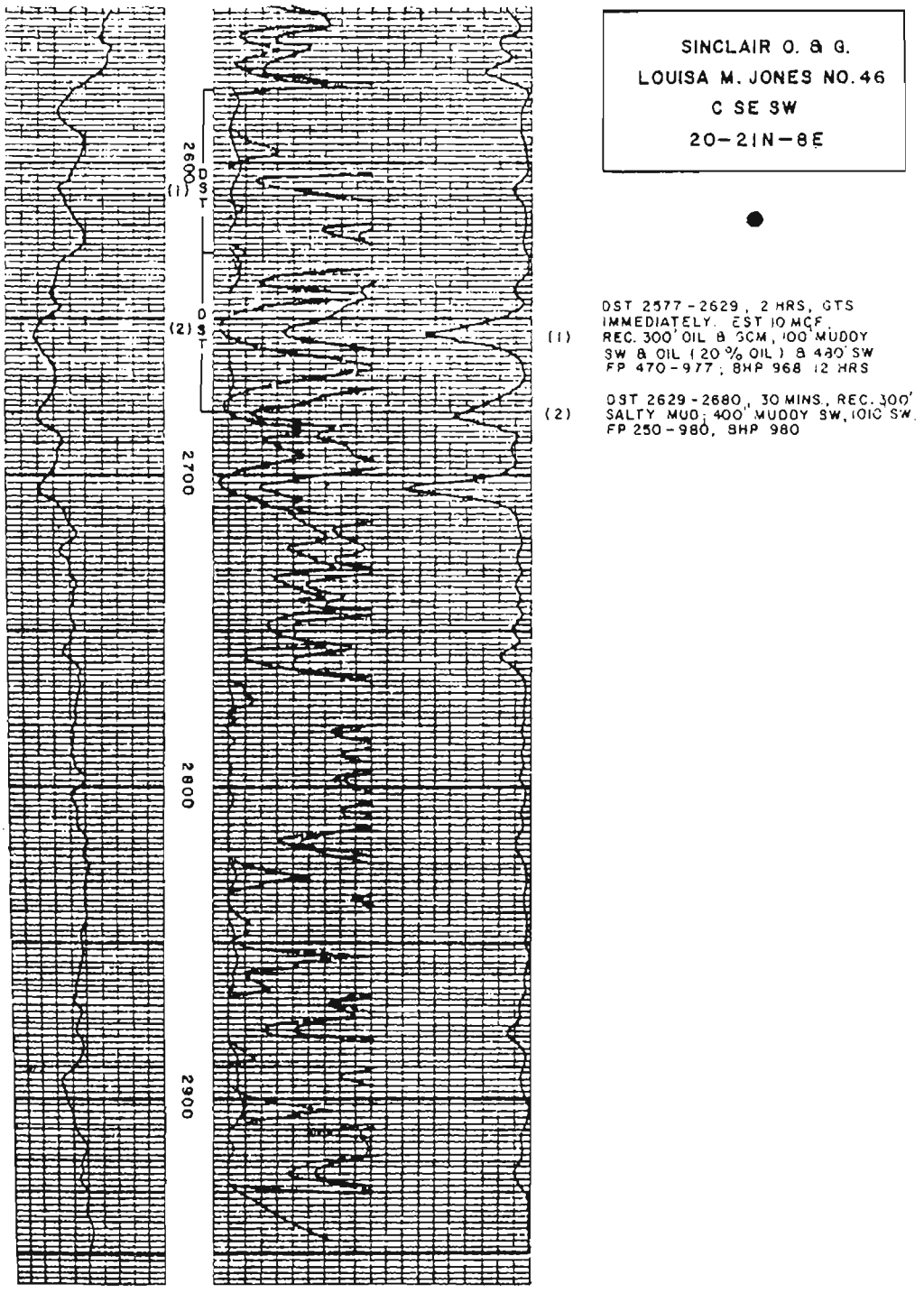
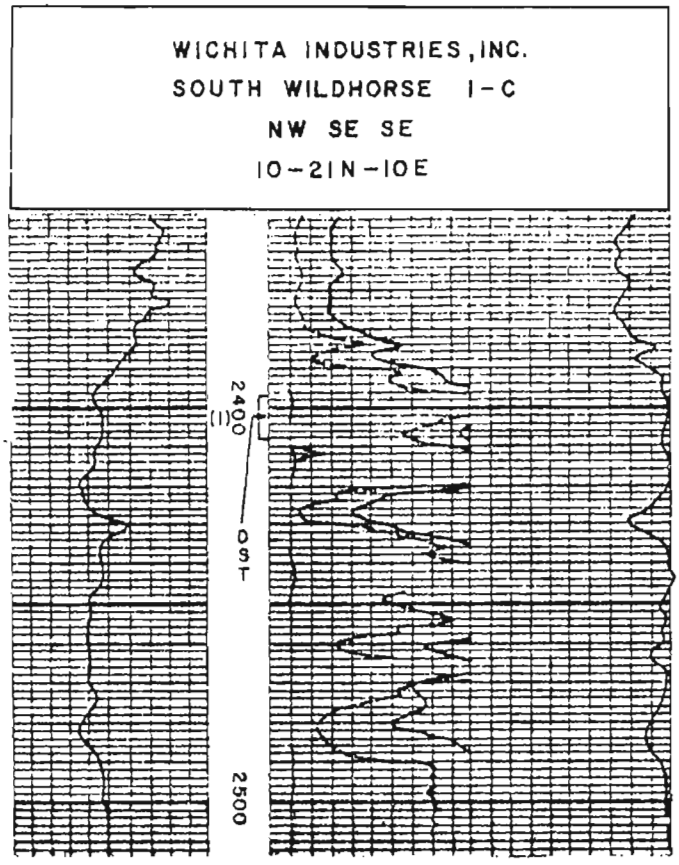


Fig. 19.-Example of results of drill-stem tests, Sinclair Jones 4



(1) DST (ARBUCKLE) 2397-2408. OP 30 MINS, SI 30, OP 1 HR, SI 60, REC 185' OCM, 615' SW. ISIP 609, IFP 41-157, FFP 165-379, FSIP 601

Fig. 20.-Example of results of drill-stem tests, Wichita Industries, South Wildhorse 1-C

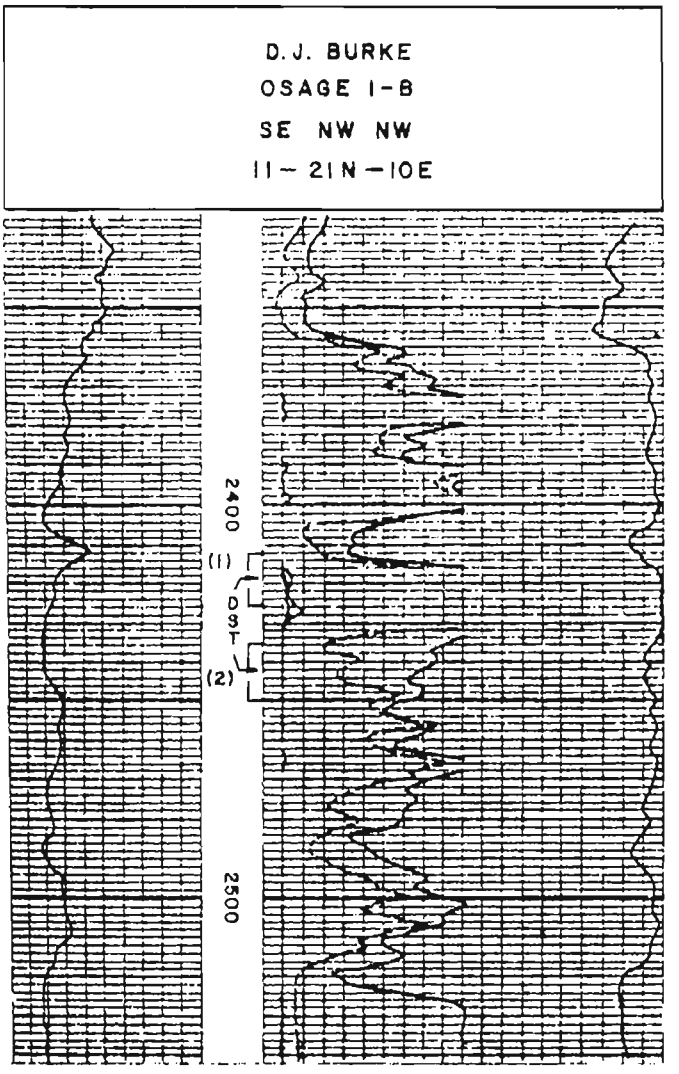
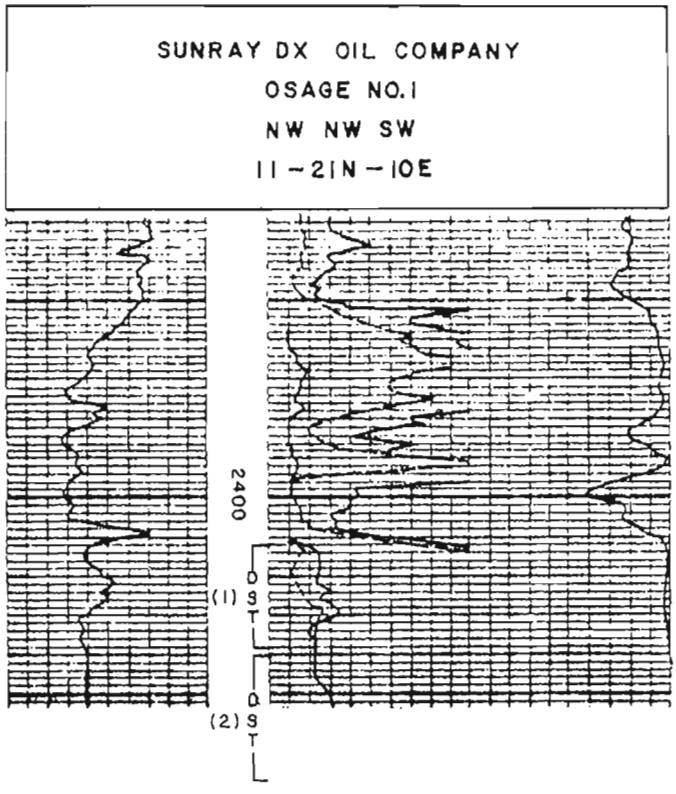


Fig. 21.-Example of results of drill-stem tests, Burke Osage 1-B



(1) DST (ARBUCKLE) 2412-2438 CONT'D: NO EST, OTS 20 MINS, FLOW 218OPH, 5/8" CK., SURFACE FP 30, REV. OUT RECOVERY, ISIP 844/30 MINS, IFP 153, FFP 480, FSIP 835/30 MINS

DD

(2) DST (ARBUCKLE) 2440-2472, OP 65 MINS, GTS/12 MINS, TSTM, GOOD BLOW DEC TO WEAK BLOW 30 MINS, REC. 610' OCM, 90' SLI SALTY MUD, 1020' SLI SWCM, 510' SLI OCSW, 320' SW, ISIP 844/30 MINS, IFP 250, FFP 250, FSIP 844/30 MINS

Fig. 22.-Example of results of drill-stem tests, Sunray Osage 1-B

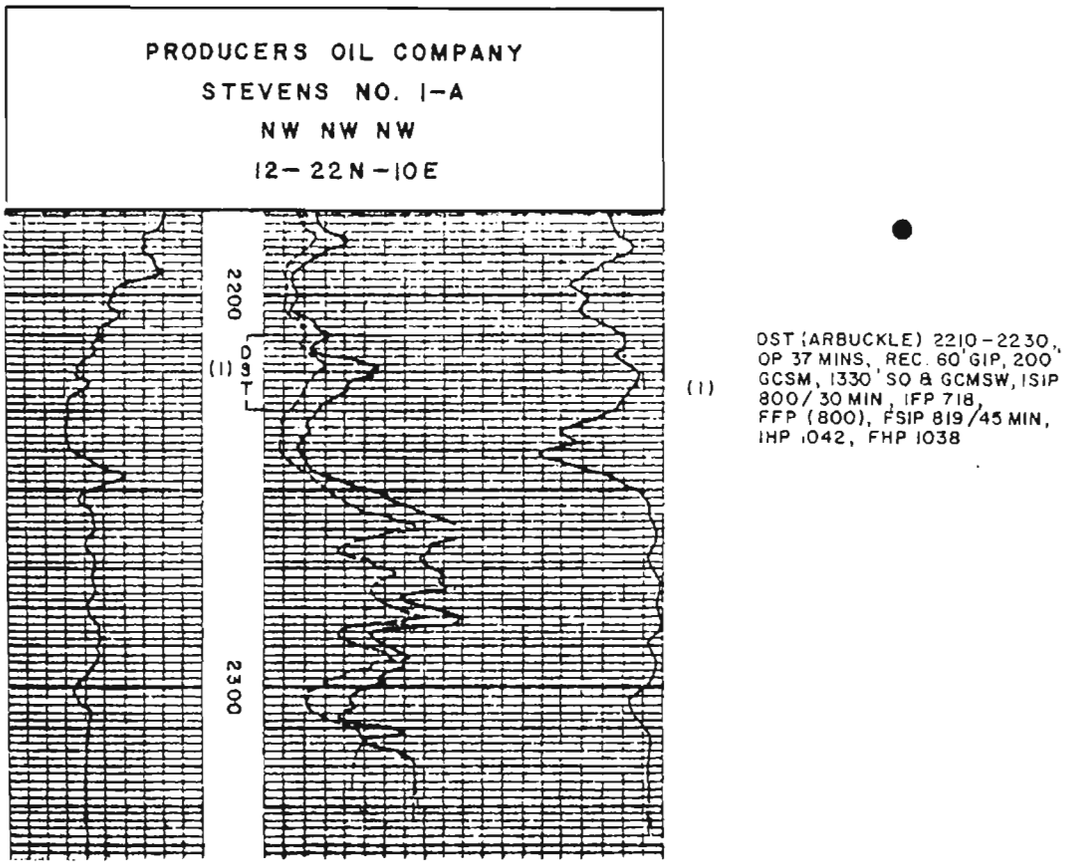


Fig. 23.-Example of results of drill-stem tests, Producers Stevens 1-A

Economics of Oil and Gas Production From the Arbuckle Group

Economics of oil and gas production from the Arbuckle Group vary a great deal, depending on such matters as amounts of water saturation, porosity, and permeability, which directly affect the amounts of fluid that can be brought into the well bore. South Canyon Creek Field, Sec. 19 and 20, T. 23 N., R. 10 E. (Pl. 1 and 2) (Table XI) is considered by the author to be a representative Arbuckle oil field. Drilling and production costs used in this analysis are derived from actual costs incurred by Berry Operating Company in wells drilled nearby in Payne and Pawnee Counties. Drilling and completion of these wells, depths, subsurface conditions, and completion techniques are not significantly different from those used in Osage County. Currently, the price of oil after taxes and royalties leaves an approximate net revenue of $26.00/bbl.

Initial production of wells in the South Canyon Creek Field ranged from 6 bbls to 545 bbls per well per day. Drilling costs are based on depths to the Precambrian rocks.

General statistics about sizes of fields and cumulative production are shown in Table XI.

TABLE XI

SUMMARY STATISTICS, ECONOMICS OF DRILLING AND COMPLETING AN ARBUCKLE OIL WELL IN THE STUDY AREA, USING SOUTH CANYON CREEK FIELD AS A MODEL

Year of Production	Number of Wells	Cumulative Production	Average Cumulative/Well
1938-1951	4	325,000+ bbls	81,000
1951-1977	2	74,000+ bbls	37,000

Total cumulative production average - 67,000 bbl/well

Cumulative production average/well	67,000.00
Ultimate recovery less royalty owner 5/6 of 6/6 0.833 x 67,000 =	56,000.00
Net $26.00/bbl of oil after federal and state taxes	$1,456,000.00
Cost of well to put in production	93,000.00
	$1,363,000.00
Lease cost, 640 acres @ $25.00/acre	16,000.00
	$1,347,000.00
Present production cost at present prices after a 13 year period at $4,800.00/year	62,400.00
Profit after payout	$1,284,600.00

Profit to investment ratio is approximately 8:1
Average time to payout at rate of 20 bbls/day: 1 year

CHAPTER VI

CONCLUSIONS

Principal conclusions of this study are as follows.

1) The Arbuckle Group in the study area has potential for hydrocarbon production throughout the Arbuckle section.

2) A highly probable correlation of the Arbuckle *ad hoc* units may be established by concurrent use of chip logs, bit cuttings, sample descriptions, and wireline logs.

3) Structural configuration of the top of the Arbuckle Group may be predicted by contouring structure on top of the Pink Limestone marker bed.

4) Positive structural features present before deposition of the Mississippian may be detected by use of isopachous maps from the top of the Arbuckle Group to (1) the base of the Mississippian and to (2) the top of the Pink Limestone. These pre-Mississippian positive structural features locally may control hydrocarbons entrapment in the Arbuckle.

5) Gamma ray-porosity logs enable correlation of porous units within the Arbuckle that may be terminated in an updip structural position, resulting in the creation of a stratigraphic trap.

6) Four basic types of traps that have potential for creating accumulation of Arbuckle hydrocarbons are (1) anticlinal and domal folding, (2) faulting, (3) lithologic changes in stratigraphy, and (4) combinations of anticlinal and domal folding with lateral

lithologic changes.

7) Precambrian paleotopographic features in the study area create stratigraphic or combination stratigraphic and structural traps due to wedging out of the Arbuckle units against these pinnacles.

8) At least 39 fields have established commercial hydrocarbon production from the Arbuckle Group within the study area.

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APPENDIX

LOCATIONS OF WELLS SHOWN ON CORRELATION SECTIONS

Correlation Section A-A'

1. Viking Petroleum Co. Boston "D" D-1
SW NW SE Sec. 1, T. 21 N., R. 7 E.

2. Sinclair Oil and Gas Co. L. M. Jones No. 46
SE SW Sec. 20, T. 20 N., R. 8 E.

3. DeMier Oil Co. Stella Maxwell No. 5
1565' SNL 1280 WEL Sec. 14, T. 22 N., R. 8 E.
(also B-3)

4. Tesoro Petroleum Corp. Trumbley No. 20-1
560' SNL 560'WEL NW Sec. 20, T. 22 N., R. 10 E.

5. Crown Central Petroleum Corp. No. 31-B
625' NSL 2070 WEL NW Sec. 32, T. 22 N., R. 10 E.

6. Wichita Industries, Inc. and Jeremiah Corp. South Wildhorse
No. 3-C 990' NSL 1650 WEL SE Sec. 10, T. 21 N., R. 10 E.

7. Wichita Industries, Inc. South Wildhorse No. 1-C 990' NSL
990 WEL SE Sec. 10, T. 21 N., R. 10 E.

8. Wichita Industries, Inc. and Jeremiah Corp. South Wildhorse
No. 2-C 330' NSL 990' WEL SE Sec. 10, T. 21 N., R. 10 E.

9. Shenandoah Oil Corp. West Shell Lake No. 2 C NE SW Sec. 26,
T. 20 N., R. 10 E.

10. Shenandoah Oil Corp. West Shell Lake No. 3 N/2 N/2 NE SW
Sec. 26, T. 20 N., R. 10 E.

11. Shenandoah Oil Corp. West Shell Lake No. 1 C N/2 SW Sec. 26,
T. 20 N., R. 10 E.

Correlation Section B-B'

1. Big Four Petroleum Co. Bird No. 5 SE NW SW Sec. 33, T. 22 N.,
R. 7 E.

2. Tomar Petroleum, Inc. Lucille Matin No. 1 NW NW SE Sec. 26,
T. 22 N., R. 7 E.

3. DeMier Oil Co. Stella Maxwell No. 5
1565 SNL 1280 WEL Sec. 14, T. 22 N., R. 8 E.

4. Lone Star Producing Co. and George M. Adams Osage Tribe
Well No. 1-A SW NW NW Sec. 9, T. 22 N., R. 9 E.

5. B.B.R. Corp. Osage Millsap No. 1
NW SW SE Sec. 19, T. 22 N., R. 10 E.

6. Sunray Oil Corp. S-3 SW Sec. 34, T. 22 N., R. 10 E.

7. Nadel and Gussman Rountree 1-A
1135' NSL 330' WEL NE Sec. 35, T. 22 N., R. 10 E.

Correlation Section C-C'

1. Johnson-Clark Drlg. Co. Wagner No. 2-A
C W/2 SW NE Sec. 6, T. 20 N., R. 8 E.

2. Sinclair Oil and Gas Co. L. M. Jones 46
C SE SW Sec. 20, T. 20 N., R. 8 E.

3. Fred DeMier Shannon No. 9
SW SE NW Sec. 13, T. 22 N., R. 8 E.

4. Arthur Silberman Kemohah No. 9
SE SW NW Sec. 9, T. 22 N., R. 8 E.

5. Bradley Production Co. Oberly Osage No. 1
SE SE NW Sec. 26, T. 23 N., R. 8 E.

6. Pure Oil Co. Osage Hominy No. 195
200' S, C, E/2 SE Sec. 4, T. 23 N., R. 8 E.

Correlation Section D-D'

1. C and E Oil Corp. Cedar Creek No. 1
NW SW SE Sec. 27, T. 22 N., R. 9 E.

2. Norbla Oil Co. J. Drummond No. 3
NE SW NE Sec. 2, T. 22 N., R. 9 E.

3. Nadel and Gussman Buell No. 1-A
C NE SW Sec. 28, T. 23 N., R. 9 E.

4. Sunray Mid-Continent Oil Co. Henry Pratt No. 1
NE NE NW Sec. 15, T. 23 N., R. 9 E.

Correlation E-E'

1. Shenandoah Oil Corp. West Shell Lake No. 2
NE SW Sec. 26, T. 20 N., R. 10 E.

2. Wichita Industries, Inc. South Wildhorse 1-C
990' NSL 990' WEL SE Sec. 10, T. 21 N., R. 10 E.

3. R. H. Burns and William V. Montin Springer No. 1-A
SW SW NW Sec. 10, T. 22 N., R. 10 E.

4. Jake L. Hamon and Edwin L. Cox Sundown No. S-7
   NE SE NW Sec. 25, T. 23 N., R. 10 E.

5. Jackson Drilling Co. Edginton No. 1
   SE SE SW Sec. 15, T. 23 N., R. 10 E.

VITA

John H. Rountree

Candidate for the Degree of

Master of Science

Thesis: PETROLEUM GEOLOGY OF THE ARBUCKLE GROUP, SOUTHERN OSAGE AND PAWNEE COUNTIES, OKLAHOMA

Major Field: Geology

Biographical:

Personal Data: Born in Wichita, Kansas, May 7, 1955. Son of Mr. and Mrs. John H. Rountree.

Education: Graduated from Putnam City West High School, Bethany, Oklahoma, in May, 1973; received a Bachelor of Science degree in geology from Oklahoma State University, Stillwater, Oklahoma, in May, 1977; completed requirements for the Master of Science degree at Oklahoma State University in May, 1980, with a major in geology.

Professional Experience: Exploration Geologist, Thomas E. Berry and Associates, February, 1977, to January, 1979; Independent Petroleum Geologist, January, 1979, to present; Member, American Association of Petroleum Geologists.

R 7 E | R 8 E | R 9 E | R 10 E

T 23 N | T 22 N | T 21 N | T 20 N

OSAGE COUNTY

PAWNEE COUNTY

CLEVELAND

HOMINY

D/U

OKLAHOMA (27) REGIONAL

SCALE

4000 0 4000 8000 12000 16000 20000 FEET

50 0 50 100 150 200 250 CHAINS

LEGEND

- LOCATION
- DRY HOLE
- OIL WELL
- ABANDONED OIL WELL
- GAS WELL
- ABANDONED GAS WELL

PINK LIMESTONE STRUCTURE MAP

OSAGE & PAWNEE COUNTIES, OKLAHOMA

CONTOUR INTERVAL: 20 FEET

GEOLOGIST: JOHN H. ROUNTREE

DATE: FEBRUARY, 1979

PLATE I

R 7 E | R 8 E | R 9 E | R 10 E

T 23 N | T 22 N | T 21 N | T 20 N

HOMINY

CLEVELAND

OSAGE COUNTY

PAWNEE COUNTY

OKLAHOMA (27) REGIONAL

SCALE

4000 0 4000 8000 12000 16000 20000 FEET

50 0 50 100 150 200 250 CHAINS

LEGEND

- LOCATION
- DRY HOLE
- OIL WELL
- ABANDONED OIL WELL
- GAS WELL
- ABANDONED GAS WELL

ARBUCKLE STRUCTURE MAP

OSAGE & PAWNEE COUNTIES, OKLAHOMA

CONTOUR INTERVAL: 20 FEET

GEOLOGIST: JOHN H. ROUNTREE

DATE: FEBRUARY, 1979

PLATE 2

R 7 E | R 8 E | R 9 E | R 10 E

T 23 N | T 22 N | T 21 N | T 20 N

OSAGE COUNTY | PAWNEE COUNTY

HOMINY | CLEVELAND

OKLAHOMA (27) REGIONAL

SCALE

4000 0 4000 8000 12000 16000 20000 FEET

50 0 50 100 150 200 250 CHAINS

LEGEND

- LOCATION
- DRY HOLE
- OIL WELL
- ABANDONED OIL WELL
- GAS WELL
- ABANDONED GAS WELL

ISOPACHOUS MAP

TOP PINK LIMESTONE TO TOP ARBUCKLE GROUP

OSAGE & PAWNEE COUNTIES, OKLAHOMA

ISOPACH INTERVAL 20 FEET

GEOLOGIST : JOHN H. ROUNTREE

DATE : FEBRUARY, 1979

PLATE 3

R 7 E | R 8 E | R 9 E | R 10 E

T 23 N | T 22 N | T 21 N | T 20 N

HOMINY

CLEVELAND

OSAGE COUNTY

PAWNEE COUNTY

OKLAHOMA (27) REGIONAL

SCALE

4000 0 4000 8000 12000 16000 20000 FEET

50 0 50 100 150 200 250 CHAINS

LEGEND

- LOCATION
- DRY HOLE
- OIL WELL
- ABANDONED OIL WELL
- GAS WELL
- ABANDONED GAS WELL

ISOPACHOUS MAP

TOP OF ARBUCKLE GROUP TO BASE OF MISSISSIPPIAN / TOP OF WOODFORD SHALE UNCONFORMITY

OSAGE & PAWNEE COUNTIES, OKLAHOMA

ISOPACH INTERVAL: 20 FEET

GEOLOGIST: JOHN H. ROUNTREE

DATE: FEBRUARY, 1979

PLATE 4

R 7 E | R 8 E | R 9 E | R 10 E

T 23 N

T 22 N

T 21 N

T 20 N

HOMINY

CLEVELAND

OSAGE COUNTY

PAWNEE COUNTY

22 N — 7 E

OKLAHOMA (27) REGIONAL

SCALE

4000 0 4000 8000 12000 16000 20000 FEET

50 0 50 100 150 200 250 CHAINS

LEGEND

- LOCATION
- DRY HOLE
- OIL WELL
- ABANDONED OIL WELL
- GAS WELL
- ABANDONED GAS WELL

⊙ ARBUCKLE PRODUCTION

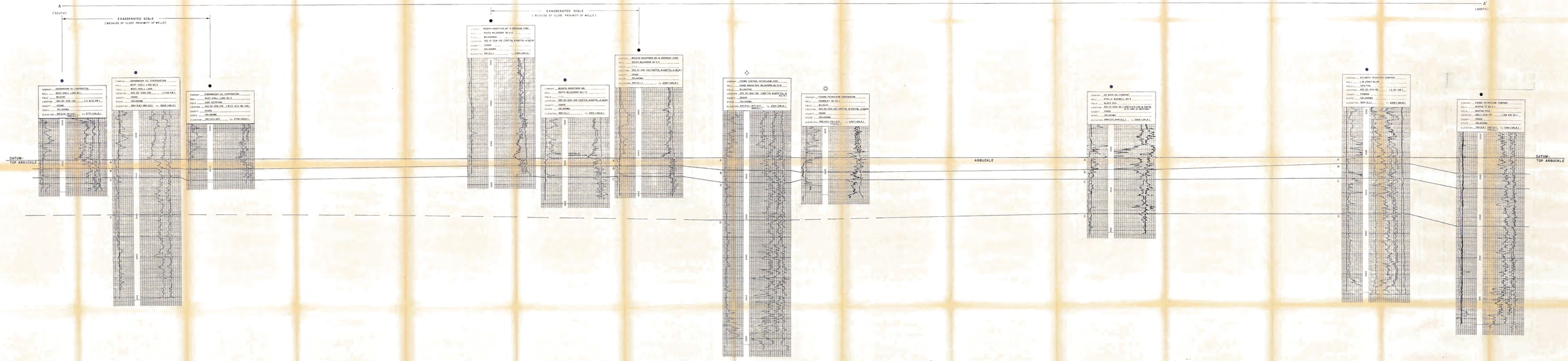
ARBUCKLE PRODUCTION MAP

OSAGE & PAWNEE COUNTIES, OKLAHOMA

GEOLOGIST : JOHN H. ROUNTREE

DATE : FEBRUARY, 1979

PLATE 5



CORRELATION SECTION A–A'

HORIZONTAL SCALE : 2" = 1 MILE
(UNLESS NOTED OTHERWISE)

VERTICAL SCALE : 1" = 40 FEET

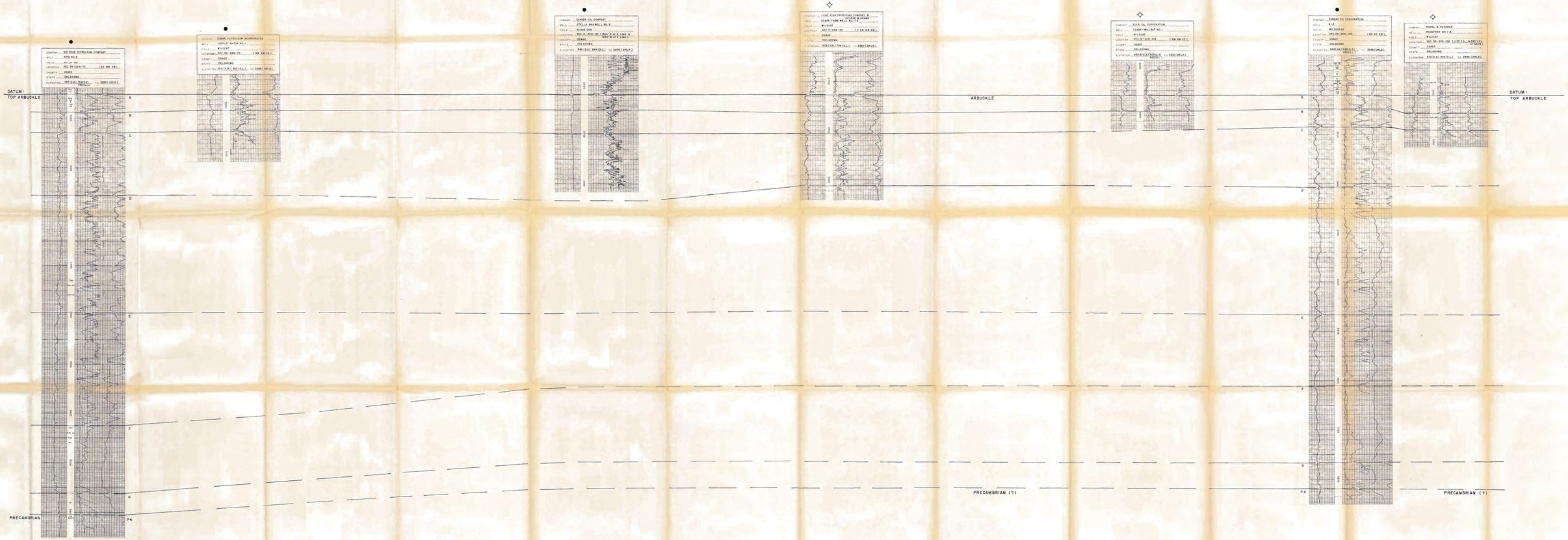
GEOLOGIST : JOHN H. ROUSTYEE

DATE : FEBRUARY, 1979

PLATE 6

B (WEST)

B' (EAST)



CORRELATION SECTION B—B'

HORIZONTAL SCALE : 3" = 1 MILE

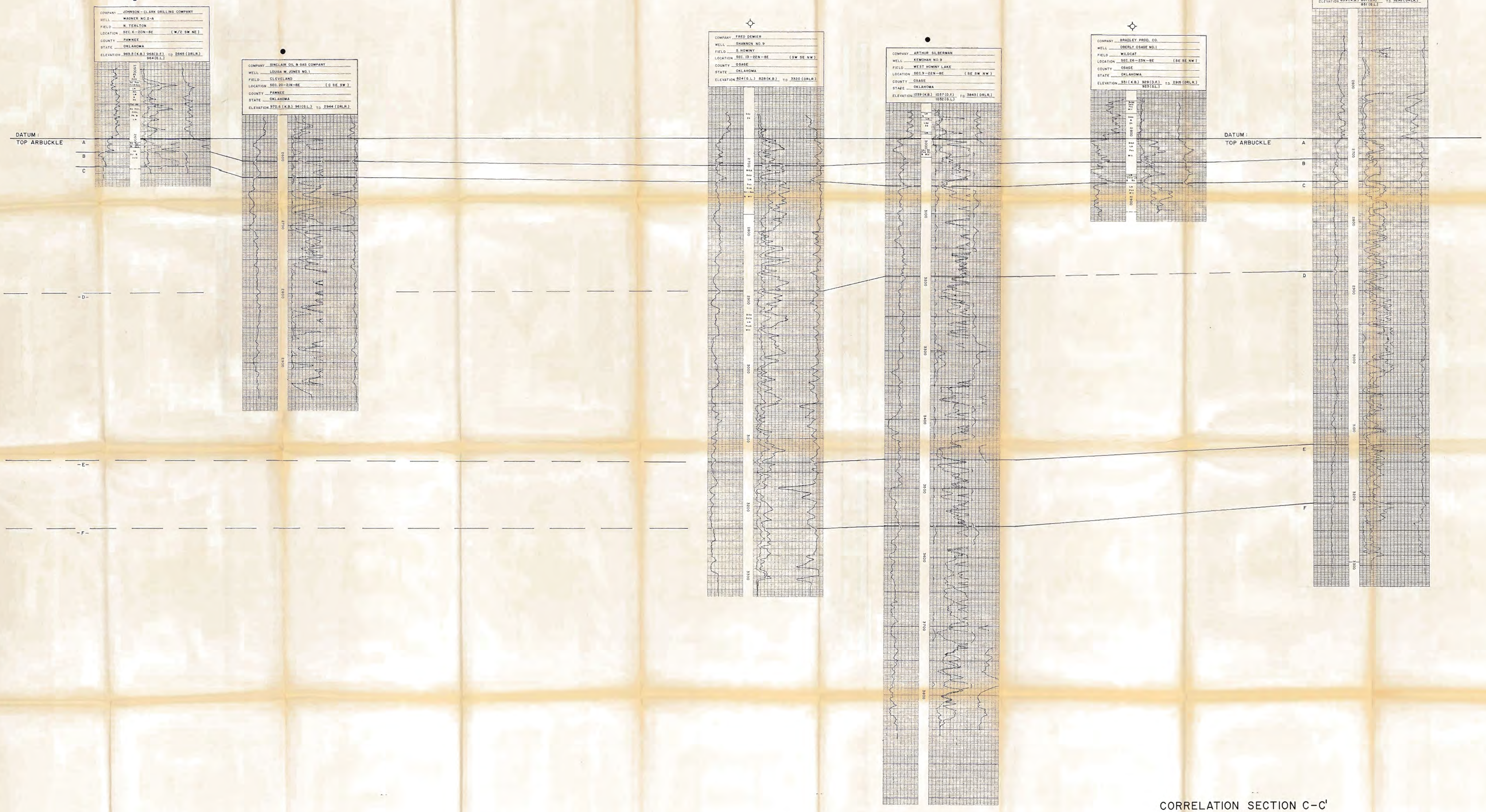
VERTICAL SCALE : 1" = 40 FEET

GEOLOGIST : JOHN H. ROUNTREE

DATE : FEBRUARY, 1979

PLATE 7

C (SOUTH) — C' (NORTH)



CORRELATION SECTION C-C'

HORIZONTAL SCALE: 2" = 1 MILE

VERTICAL SCALE: 1" = 40 FEET

GEOLOGIST: JOHN H. ROUNTREE

DATE: FEBRUARY, 1979

PLATE 8

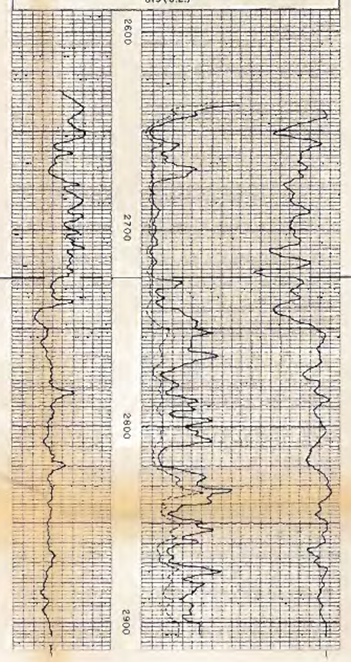
D

(SOUTH)

D'

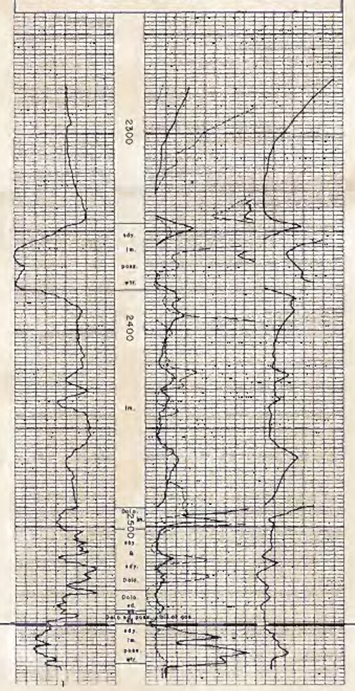
(NORTH)

COMPANY C. B E. OIL CORPORATION
WELL CEDAR CREEK NO.1
FIELD ---
LOCATION SEC. 27-22N-9E (NW SW SE)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 825(K.B.) 823(D.F.) 819(G.L.) T.D. 2904 (DRLG.) (LOG)



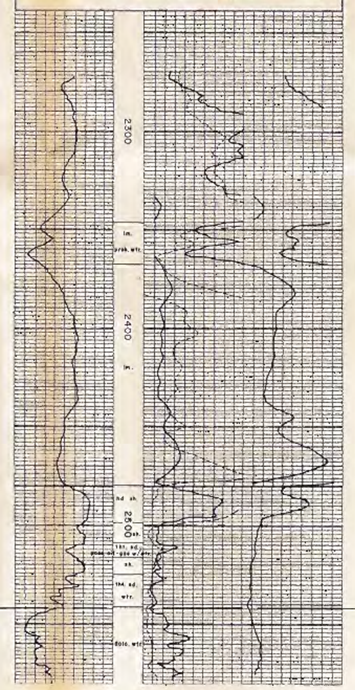
DATUM:
TOP ARBUCKLE

COMPANY NORBLA OIL COMPANY
WELL J. DRUMMOND NO.3
FIELD SE. HOMINY
LOCATION SEC. 2-22N-9E (NE SW NE)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 836(K.B.) 830(G.L.) T.D. 2569

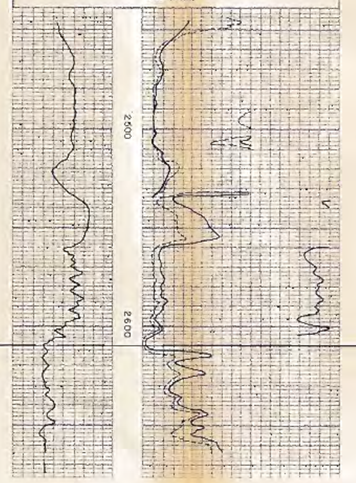


ARBUCKLE LS.

COMPANY NADEL & GUSSMAN
WELL BUELL NO.1A
FIELD WILDCAT
LOCATION SEC. 28-23N-9E (C NE SE)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 783(K.B.) 778(G.L.) T.D. 2574(DRLR.)



COMPANY SUNRAY MID-CONTINENT OIL COMPANY
WELL HENRY PRATT NO.1
FIELD WILDCAT
LOCATION SEC. 15-23N-9E (NE NE NW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 818(D.F.) 820.8(K.B.) 812 (G.L.) T.D. 2659



DATUM:
TOP ARBUCKLE

CORRELATION SECTION D-D'

HORIZONTAL SCALE: 2" = 1 MILE

VERTICAL SCALE: 1" = 40 FEET

GEOLOGIST: JOHN H. ROUNTREE

DATE: FEBRUARY, 1979

PLATE 9

E (SOUTH)

E' (NORTH)

DATUM: TOP ARBUCKLE

DATUM: TOP ARBUCKLE

A

B

C

D

E

F

COMPANY SHENANDOAH OIL CORP.
WELL WEST SHELL LAKE NO. 2
FIELD WEST SHELL LAKE
LOCATION SEC. 26-20N-10E (C NE SW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 884 (K.B.) 882 (D.F.) 877 (G.L.) TD 3006 (DRLR.)

COMPANY WICHITA INDUSTRIES INC.
WELL SOUTH WILDHORSE NO. 1-C
FIELD ---
LOCATION SEC. 10-21N-10E (NE SE SE)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 934 (G.L.) TD 2500 (DRLR.)

COMPANY R.H. BURNS & Wm. V. MONTIN
WELL SPRINGER NO. 1-A
FIELD WILDCAT
LOCATION SEC. 10-22N-10E (SW SW NW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 769 (K.B.) 765 (G.L.) TD 2400 (DRLR.)

COMPANY JAKE L. HAMON & EDWIN L. COX
WELL SUNDOWN NO. 5-7
FIELD SUNDOWN UNIT
LOCATION SEC. 28-23N-10E (NE SE NW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 822 (K.B.) 818 (G.L.) TD 2762 (DRLR.)

COMPANY JACKSON DRLR. CO.
WELL EDSINTON NO. 1
FIELD WILDCAT
LOCATION SEC. 18-23N-10E (SE SE SW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 892 (K.B.) 891 (D.F.) 884 (G.L.) TD 2518 (DRLR.)

CORRELATION SECTION E—E'

HORIZONTAL SCALE : 2" = 1 MILE
VERTICAL SCALE : 1" = 40 FEET

GEOLOGIST : JOHN H. ROUNTREE
DATE : FEBRUARY, 1979

PLATE 10

PLATE II

CORRELATION SECTION F–F'

HORIZONTAL SCALE : 3" = 1 MILE

VERTICAL SCALE : 1" = 40 FEET

GEOLOGIST : JOHN H. ROUNTREE

DATE : FEBRUARY, 1979

F (WEST)

F' (EAST)

DATUM : TOP ARBUCKLE

ARBUCKLE

PRECAMBRIAN

PC GRANITE

A B C D E F

COMPANY JAKE L. HAMON & EDWIN L. COX
WELL SUNDOWN NO. S-7
FIELD SUNDOWN UNIT
LOCATION SEC. 25–23N–10E (NE SE NW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 828.5 (K.B.) 818 (G.L.) T.D. 2982 (DRLR.)

COMPANY FRANK BUTRAM
WELL CECIL NO. 1-A
FIELD WILDCAT
LOCATION SEC. 32–23N–10E (SW SE NW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 923 (G.L.) T.D. 2560 (DRLR.)

COMPANY NADEL & GUSSMAN
WELL ABRAHAM NO. 1-A
FIELD WILDCAT
LOCATION SEC. 30–23N–10E (SE NE NE)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 849 (K.B.) 841 (G.L.) T.D. 2550 (DRLR.)

COMPANY D.R. LAUCK
WELL DRUMMOND NO. 1
FIELD WILDCAT
LOCATION SEC. 26–23N–9E (SW SW NW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 860 (G.I) 851 (K.B.) 837 (G.L.) T.D. 2640 (DRLR.)

COMPANY NADEL & GUSSMAN
WELL BUELL NO. 1A
FIELD WILDCAT
LOCATION SEC. 28–23N–9E (C NW SE)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 783 (K.B.) 774 (G.L.) TD. 2574 (DRLR.) (LOG)

COMPANY EDWIN L. COX
WELL MANION UNIT S-42
FIELD MANION
LOCATION SEC. 19–23N–9E (C E/2 E/2 SW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 800 (G.L.) TD. 2901 (LOG) 2917 (DRLR.)

COMPANY BRADLEY PROD. CO.
WELL OBERLEY OSAGE NO. 1
FIELD WILDCAT
LOCATION SEC. 26–23N–8E (SE SE NW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 929 (G.F.) 951 (K.B.) TD. 2915 (LOG) 2914 (DRLR.)

COMPANY FRED DEMEIR
WELL MONEY TREE NO. 1-A
FIELD PETTIT
LOCATION SEC. 29–23N–8E (NW NE NW)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 1064.4 (K.B.) 1050.4 (G.L.) TO 2935 (DRLR.)

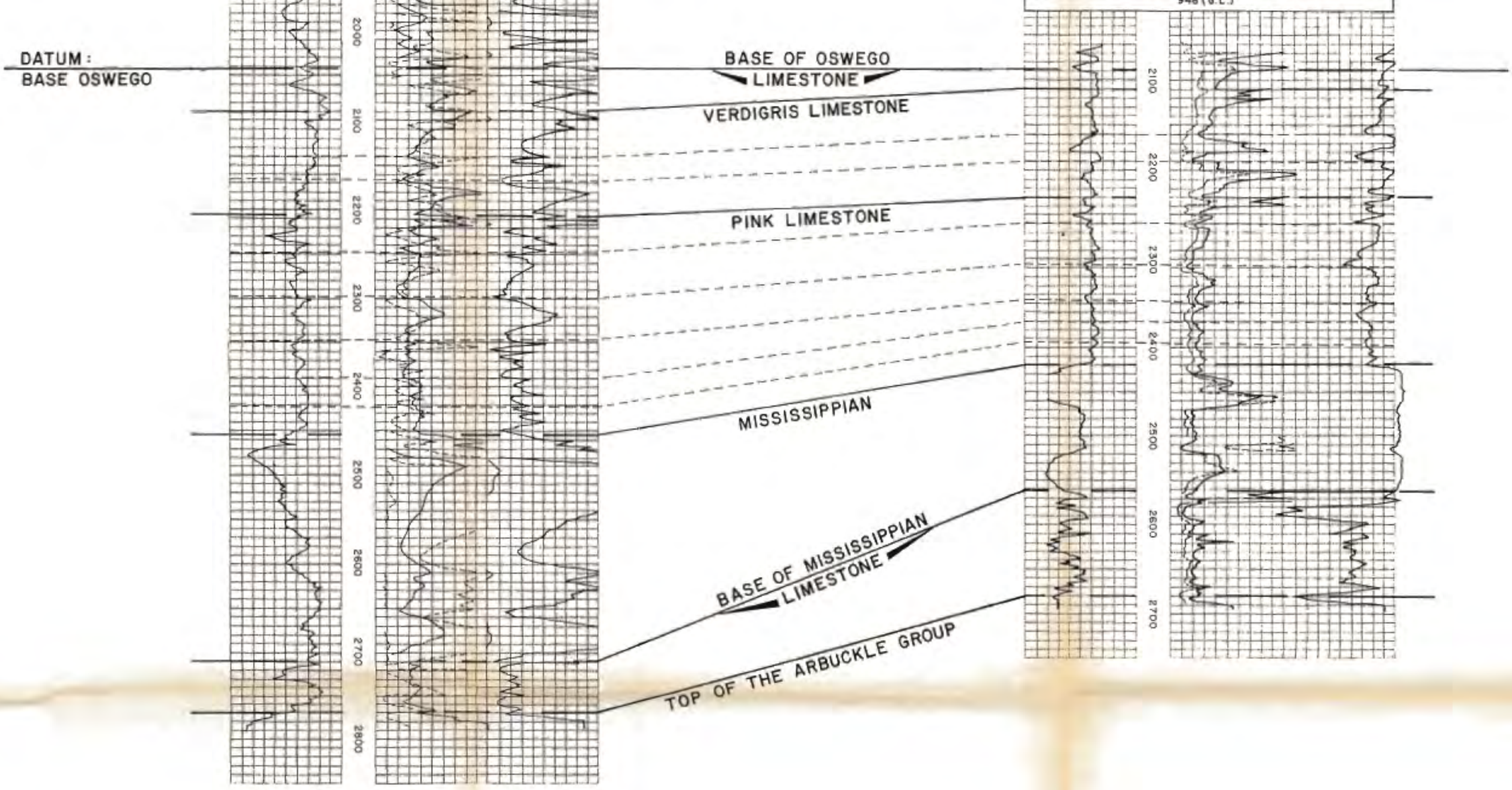
COMPANY NADEL & GUSSMAN & GOLDEN OIL CO.
WELL BERNI NO. 1
FIELD WILDCAT
LOCATION SEC. 1–22N–7E (NW NW SE)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 967 (K.B.) 942 (G.L.) TO 3027 (DRLR.)

G — G'

(SOUTH) (NORTH)

COMPANY JERNIGAN & MORGAN
WELL OSAGE GRAHAM NO. 1
FIELD BLACK DOG
LOCATION SEC. 15-22N-8E (NW SW NE)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 936 (D.F.) 937 (K.B.) 928 (G.L.) T.D. 2784

COMPANY GULF OIL CORPORATION
WELL LAURA SHANNON NO. 1
FIELD
LOCATION SEC. 10-22N-8E (SW NW SE)
COUNTY OSAGE
STATE OKLAHOMA
ELEVATION 951 (D.F.) 953 (K.B.) 948 (G.L.) T.D. 2687



CORRELATION SECTION G — G'

HORIZONTAL SCALE : 6" = 1 MILE

VERTICAL SCALE : 1" = 100 FEET

GEOLOGIST : JOHN H. ROUNTREE

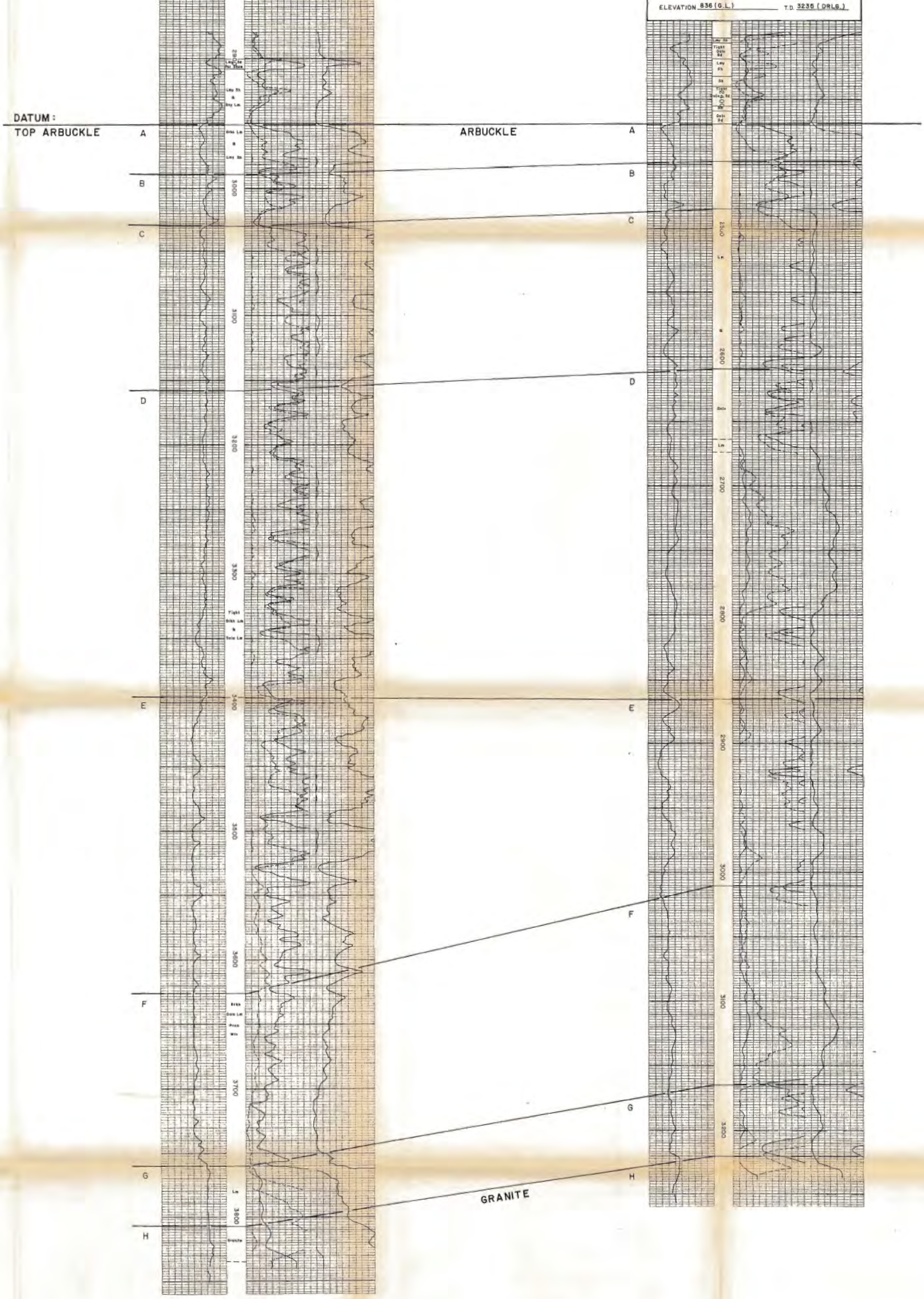
DATE : FEBRUARY, 1979

PLATE 12

WEST — EAST

COMPANY	BIG FOUR PETROLEUM COMPANY
WELL	BIRD NO. 5
FIELD	
LOCATION	SEC. 33-22N-7E (SE NW SW)
COUNTY	OSAGE
STATE	OKLAHOMA
ELEVATION	757(K.B.) 754(D.F.) 749(G.L.)
T.D.	3835(DRLR.)

COMPANY	SUNRAY OIL CORPORATION
WELL	S-3
FIELD	WILDHORSE
LOCATION	SEC. 34-22N-10E (NE NE SW)
COUNTY	OSAGE
STATE	OKLAHOMA
ELEVATION	836 (G.L.)
T.D.	3236 (DRLG.)



CORRELATION SECTION

HORIZONTAL SCALE : 1" = 2 MILES

VERTICAL SCALE : 1" = 40 FEET

GEOLOGIST : JOHN H. ROUNTREE

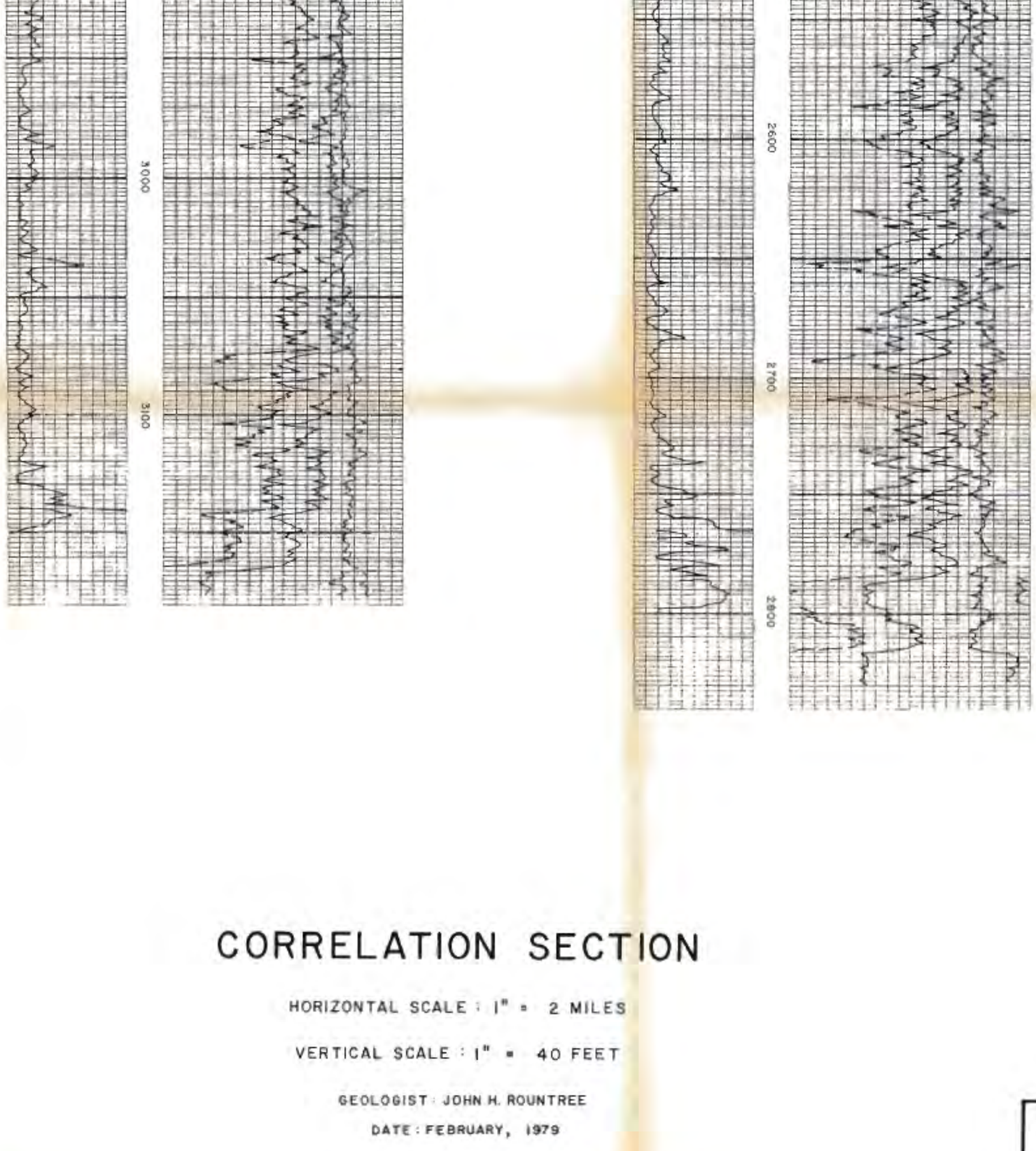
DATE : FEBRUARY, 1979

PLATE 13

WEST — EAST

COMPANY	VIKING PETROLEUM COMPANY
WELL	BOSTON "D" NO. D-1
FIELD	BOSTON POOL
LOCATION	SEC. 1-21N-7E (SW NW SE)
COUNTY	OSAGE
STATE	OKLAHOMA
ELEVATION	783 (K.B.) 782 (D.F.) 775 (G.L.)
T.D.	3164 (DRLR.)

COMPANY	CROWN CENTRAL PETROLEUM CORPORATION
WELL	OSAGE INDIAN RESERVATION WILDHORSE NO. 31-8
FIELD	WILDHORSE
LOCATION	SEC. 32-22N-10E (625' FSL & 2070' FEL)
COUNTY	OSAGE
STATE	OKLAHOMA
ELEVATION	818 (K.B.) 817 (D.F.) 809 (G.L.)
T.D.	2814 (DRLR.)



CORRELATION SECTION

HORIZONTAL SCALE : 1" = 2 MILES

VERTICAL SCALE : 1" = 40 FEET

GEOLOGIST : JOHN H. ROUNTREE

DATE : FEBRUARY, 1979

PLATE 14

R7E R8E R9E R10E

T 23 N

T 22 N

T 21 N

T 20 N

OSAGE COUNTY
PAWNEE COUNTY
22 N — 7 E
HOMINY
CLEVELAND
A
B
B'
C'
D
D'
E'
F
F'
G
G'
A-8-E

OKLAHOMA (27) REGIONAL

SCALE

4000 0 4000 8000 12000 16000 20000 FEET

50 0 50 100 150 200 250 CHAINS

LEGEND

- LOCATION
- DRY HOLE
- OIL WELL
- ABANDONED OIL WELL
- GAS WELL
- ABANDONED GAS WELL

INDEX MAP of CORRELATION SECTIONS

GEOLOGIST : JOHN H. ROUNTREE

DATE : FEBRUARY, 1979

PLATE 15